

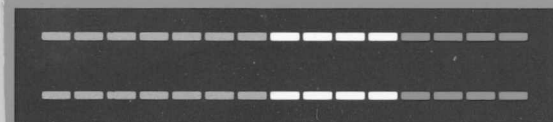
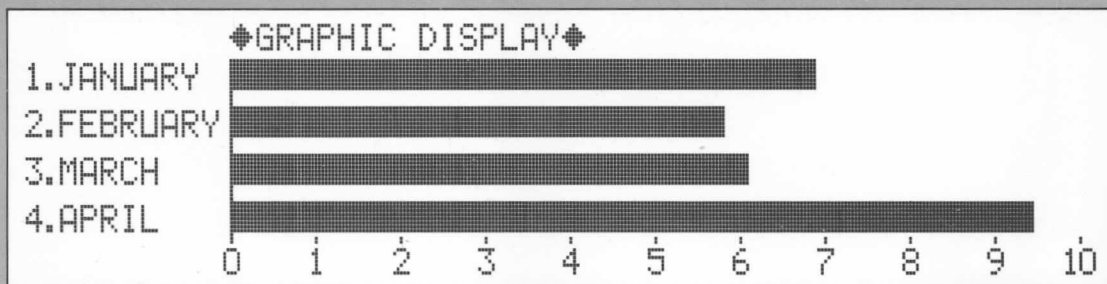


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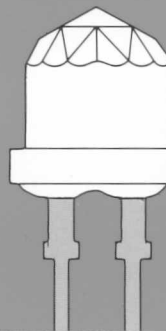
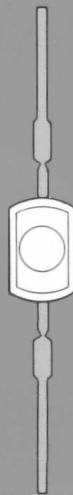
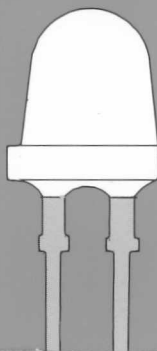
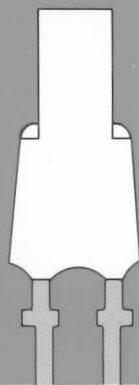
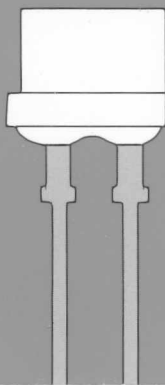
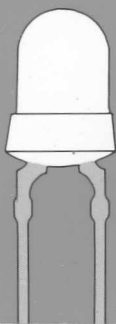
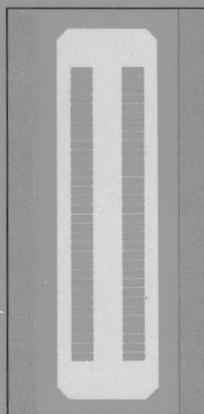
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Including Comprehensive Applications Notes and Support Data

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AND is a division of the William J. Purdy Company, a firm that has been a dynamic marketing force in the highly competitive electronics industry since 1929.

The AND division was established in 1978 to specifically serve the liquid crystal display (LCD) and light emitting diode (LED) lamp and display markets. From our inception, we have worked to accomplish the following objectives:

1. To supply the highest quality LCD & LED products
2. To establish and maintain a leading position in technological development in the LCD market in terms of:
 - a. Expansion of environmental parameters for liquid crystal displays.
 - b. Development of dot matrix, alpha numeric and graphic liquid crystal display systems.
 - c. Development of custom displays to customer engineering specifications.
3. To establish both technical information and product support at local levels through a broad network of representatives and distributors.

4. To establish and maintain generous inventory levels of standard LCD and LED products in order to provide immediate delivery, at the local distributor level, backed up by AND Burlingame headquarters.

This comprehensive catalog provides complete technical data on our entire product line. And a lot more!

In addition, we've gone to considerable expense to develop and include a broad range of applications notes and support data for the design engineer. We believe this unique document is the most complete presentation available today, and hope you will find it a most useful reference book.

PLEASE NOTE: All product specifications are intentionally conservative—and you can be assured AND displays will exceed performance characteristics contained herein in virtually all applications.

We thank you for your interest in the AND product line and stand ready to serve you in any way possible. In the event you require additional technical or pricing information, please call one of our applications engineers at 415/347-9916, or contact one of our representatives listed on page 6-2.

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STANDARD BRIGHT							
	T1¾	Part Number	Color	Lens Color	Typical Luminous Intensity		Page
	I _V (mcd)				I _F (mA)		
	AND113R AND113RP	Red Red	Red, clear	7	15	1-7	
	AND113S	Red	Red, clear	25	15		
	AND114R AND114RP	Red Red	Red, diffused	3	15		
	AND114S	Red	Red, diffused	8	15		
	AND113G AND113GP	Green Green	Green, clear	30	15		
	AND114G AND114GP	Green Green	Green, diffused	8	15		
	AND113Y AND113YP	Yellow Yellow	Yellow, clear	20	15		
	AND114Y AND114YP	Yellow Yellow	Yellow, diffused	6	15		
	AND113O AND113OP	Orange Orange	Orange, clear	20	15		
	AND114O AND114OP	Orange Orange	Orange, diffused	6	15		
	T1	Part Number	Color	Lens Color	Typical Luminous Intensity		Page
I _V (mcd)	I _F (mA)						
	AND123R	Red	Red, clear	3.5	10	1-7	
	AND124R	Red	Red, diffused	2.5	10		
	AND163S	Red	Red, clear	40	20		
	AND164S	Red	Red, diffused	20	20		
	AND123G	Green	Green, clear	10	10		
	AND124G	Green	Green, diffused	5	10		
	AND163G	Green	Green, clear	30	20		
	AND164G	Green	Green, diffused	15	20		
	AND123Y	Yellow	Yellow, clear	5	10		
	AND124Y	Yellow	Yellow, diffused	4	10		
	AND163Y	Yellow	Yellow, clear	20	20		
	AND164Y	Yellow	Yellow, diffused	10	20		
	AND163O	Orange	Orange, clear	40	20		
	AND164O	Orange	Orange, diffused	20	20		
	ULTRA BRIGHT						
	T1 ¾	Part Number	Color	Lens Color	Typical Luminous Intensity		Page
	I _V (mcd)				I _F (mA)		
	AND181RCP	Red	Red, clear	500	20	1-13	
	AND182RCP	Red	Red, diffused	300	20		
	AND181URP	Red	Lt red, clear	250	20		
	AND182URP	Red	Lt red, diffused	150	20		
	AND181SP	Red	Lt red, clear	150	20		
	AND182SP	Red	Lt red, diffused	90	20		
	AND181RP	Red	Lt red, clear	50	20		
	AND182RP	Red	Lt red, diffused	25	20		
	AND181GP	Green	Lt green, clear	200	20		
	AND182GP	Green	Lt green, diffused	120	20		
	AND181YP	Yellow	Lt yellow, clear	150	20		
	AND182YP	Yellow	Lt yellow, diffused	90	20		
	AND181OP	Orange	Lt orange, clear	150	20		
AND182OP	Orange	Lt orange, diffused	90	20			



		T1			Typical Luminous Intensity		Page
		Part Number	Color	Lens Color	I _V (mcd)	I _F (mA)	
		AND163UR	Red	Lt red, clear	100	20	1-13
		AND164UR	Red	Lt red, diffused	40	20	
		AND163UG	Green	Lt green, clear	70	20	
		AND164UG	Green	Lt green, diffused	30	20	
		AND163UY	Yellow	Lt yellow, clear	40	20	
		AND164UY	Yellow	Lt yellow, diffused	20	20	
STRIKING BRIGHT							
		8 mm/10 mm			Typical Luminous Intensity		Page
		Part Number	Color	Lens Color	I _V (mcd)	I _F (mA)	
		AND190GCP	Green	Colorless clear	2000	20	1-18
		AND191GCP	Green	Milky, diffused	200	20	
		AND185GCP	Green	Colorless clear	500	20	
		AND187GCP	Green	Colorless clear	200	20	
		T1¾			Typical Luminous Intensity		Page
		Part Number	Color	Lens Color	I _V (mcd)	I _F (mA)	
		AND180QRP	Red	Colorless clear	720	20	1-18
		AND135NR	Red	Colorless clear	230	20	
		AND134MR	Red	Red, diffused	128	20	
		AND114KR	Red	Red, diffused	41	20	
		AND180PGP	Green	Colorless clear	410	20	
		AND135NGP	Green	Colorless clear	230	20	
		T1			Typical Luminous Intensity		Page
		Part Number	Color	Lens Color	I _V (mcd)	I _F (mA)	
		AND163QR	Red	Lt red, diffused	720	20	1-18
		AND160RC	Red	Colorless clear	200	20	
		AND125RC	Red	Colorless clear	50	20	
		AND124KR	Red	Red, diffused	41	20	
		AND160NG	Green	Colorless clear	230	20	
KILO BRIGHT							
		8 mm/10 mm			Typical Luminous Intensity		Page
		Part Number	Color	Lens Color	I _V (mcd)	I _F (mA)	
		AND190CRP	Red	Colorless clear	13000	20	1-23
		AND190BRP	Red	Colorless clear	7200	20	
		AND191CRP	Red	Milky, diffused	720	20	
		AND191BRP	Red	Milky, diffused	410	20	
		AND185ARP	Red	Colorless clear	3000	20	
		AND187ARP	Red	Colorless clear	1000	20	



T1¼	Part Number	Color	Lens Color	Typical Luminous Intensity		Page
				I _v (mcd)	I _f (mA)	
1-23	AND180CRP	Red	Colorless clear	4100	20	
	AND180BRP	Red	Colorless clear	2300	20	
	AND180ASP	Red	Colorless clear	1000	20	
	AND130CR	Red	Colorless clear	2300	20	
	AND130BR	Red	Colorless clear	1280	20	
	AND155CRP	Red	Colorless clear	1280	20	
	AND155BRP	Red	Colorless clear	720	20	
	AND155ASP	Red	Colorless clear	300	20	
	AND120CR	Red	Colorless clear	1280	20	
	AND120BR	Red	Colorless clear	720	20	
	AND134CR	Red	Red, diffused	230	20	
	AND134BR	Red	Red, diffused	208	20	
	AND116CR	Red	Milky, diffused	208	20	
AND116BR	Red	Milky, diffused	72	20		
T1	Part Number	Color	Lens Color	Typical Luminous Intensity		Page
				I _v (mcd)	I _f (mA)	
	AND125CR	Red	Colorless clear	400	20	1-23
	AND126CR	Red	Milky, diffused	150	20	
T1	Part Number	Color	Lens Color	Typical Luminous Intensity		Page
				I _v (mcd)	I _f (mA)	
	AND125CR (0.5 mA)	Red	Colorless clear	4	2	1-23
AND126CR (0.5 mA)	Red	Milky, diffused	2	2		



FIBER OPTIC EMITTER

	Part Number	Color	Lens Color	Typical Luminous Intensity		Page
				I _V (mcd)	I _F (mA)	
	AND280R	Red	—	—	—	1-29
	AND281R	Red	—	—	—	

DUAL COLOR

	Part Number	Color	Lens Color	Typical Luminous Intensity		Page
				I _V (mcd)	I _F (mA)	
	AND101RG	Red/Green	Milky, diffused	0.75 / 1.5	20	1-31
	AND126SG	Red/Green	Milky, diffused	5.0 / 4.5	10	
	AND116SG	Red/Green	Milky, diffused	7.0 / 5.0	15	
	AND116YG	Yellow/Green	Milky, diffused	5.0 / 5.0	15	
	AND171SG	Red / Green	Milky, diffused	6.0 / 12.0	20	
	AND177RAG	Red / Green	Colorless clear	900 / 150	20	
	AND182SG	Red / Green	Milky, diffused	15.0 / 12.0	20	
	AND205SG	Red / Green	Milky, diffused	1.5 / 1.5	15	
	AND187RAG	Red / Green	Colorless clear	900 / 150	20	
	AND2451RGL	Red/Green	Milky, diffused	1.2 / 1.7	10	
	AND208SG	Red/Green	Milky, diffused	1.5 / 1.5	15	
	AND208YG	Yellow/Green	Yellow, diffused	1.5 / 1.5	15	
	AND222SG	Red/Green	Colorless clear	6.0 / 9.0	15	
	AND264SG	Red/Green	Milky, diffused	5.0 / 5.0	15	

DUAL CHIP

	T1¾	Part Number	Color	Lens Color	Typical Luminous Intensity		Page
					I _V (mcd)	I _F (mA)	
		AND255AS	Red	Lt red, clear	30	20	1-40
		AND255AG	Green	Lt green, clear	25	20	
		AND255AY	Yellow	Lt yellow, clear	20	20	
		AND255AO	Orange	Lt orange, clear	20	20	
		AND256CR	Red	Colorless clear	350	20	
		AND256GC	Green	Colorless clear	90	20	

AC LAMP

	T1¾	Part Number	Color	Lens Color	Typical Luminous Intensity		Page
					I _V (mcd)	I _F (mA)	
		AND170S	Red	Red, clear	10	20	1-44
		AND171S	Red	Red, diffused	6	20	
		AND170G	Green	Green, clear	20	20	
		AND171G	Green	Green, diffused	12	20	
		AND170Y	Yellow	Yellow, clear	10	20	
		AND171Y	Yellow	Yellow, diffused	6	20	
		AND170O	Orange	Orange, clear	10	20	
		AND171O	Orange	Orange, diffused	6	20	



RECTANGULAR

Part Number	Color	Lens Color	Typical Luminous Intensity		Page
			I _V (mcd)	I _F (mA)	
AND221S	Red	Red, clear	5	15	1-47
AND221RC	Red	Colorless clear	10	15	
AND221G	Green	Lt green, clear	7	15	
AND221Y	Yellow	Lt yellow, clear	5	15	
AND209R	Red	Red, diffused	0.8	10	
AND209G	Green	Green, diffused	1.5	10	
AND209Y	Yellow	Yellow, diffused	1.3	10	
AND205R	Red	Red, diffused	0.5	10	
AND205G	Green	Green, diffused	0.7	15	
AND205Y	Yellow	Yellow, diffused	1.1	15	
AND211R	Red	Red, diffused	1.2	20	
AND211G	Green	Green, diffused	1.2	20	
AND211Y	Yellow	Yellow, diffused	1.2	20	
AND208R	Red	Red, diffused	0.5	15	
AND208G	Green	Green, diffused	1.2	15	
AND208Y	Yellow	Yellow, diffused	0.9	15	
AND218SP	Red	Red, diffused	2.4	15	
AND218GP	Green	Green, diffused	4	15	
AND218YP	Yellow	Yellow, diffused	1.5	15	
AND251S	Red	Red, diffused	5	15	
AND251G	Green	Green, diffused	9	15	
AND251Y	Yellow	Yellow, diffused	5	15	

SPECIAL SHAPE

Part Number	Color	Lens Color	Typical Luminous Intensity		Page
			I _V (mcd)	I _F (mA)	
AND207R	Red	Red, diffused	0.7	15	1-52
AND207G	Green	Green, diffused	1.3	15	
AND207Y	Yellow	Yellow, diffused	1	15	
AND206R	Red	Red, diffused	0.8	15	
AND206G	Green	Green, diffused	1.6	15	
AND206Y	Yellow	Yellow, diffused	1.4	15	
AND226R	Red	Red, diffused	0.5	10	
AND226G	Green	Green, diffused	0.5	10	
AND226Y	Yellow	Yellow, diffused	0.5	10	
AND147R	Red	Red, clear	1.5	15	
AND147G	Green	Green, clear	5	15	
AND147Y	Yellow	Yellow, clear	4.5	15	
AND115R	Red	Red, clear	3	15	
AND115G	Green	Green, clear	16	15	
AND145R	Red	Red, clear	3.5	15	
AND145G	Green	Green, clear	12	15	

VISIBLE LASER DIODE ASSEMBLIES

VISIBLE LASER DIODE ASSEMBLIES ARE ALSO AVAILABLE. CONTACT FACTORY FOR MORE INFORMATION

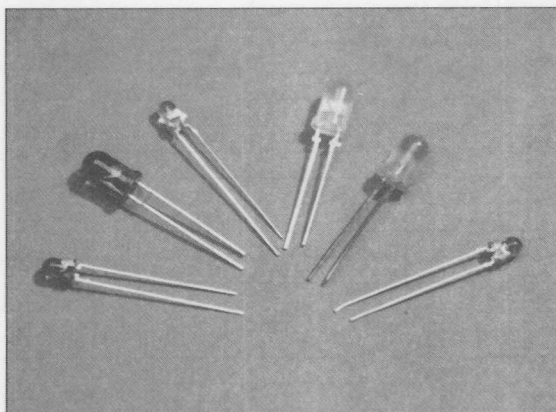


LED Lamps

STANDARD BRIGHT

T1 $\frac{3}{4}$ AND113(P) Series
AND114(P) Series

T1

AND163 Series
AND164 Series
AND123 Series
AND124 Series

FEATURES

- Low power requirement
- Stand-off or flush-mount
- All plastic molded lens
- Choice of 4 colors
 - GaP-red
 - GaP-green
 - GaAsP-yellow
 - GaAsP-orange

1

AND113 and 114 Series - T1 $\frac{3}{4}$ Package - Standard Bright

Part Number	Color		Lens Description	Axial Luminous Intensity (mcd)		Test Condition (I _F -mA)	Viewing Angle 2 θ $\frac{1}{2}$ (deg)
	Led	Lens		Min.	Typ.		
AND113R	Red	Red	Clear	3.5	7	15	50
AND114R	Red	Red	Diffused	1.5	3	15	80
AND113S	Red	Red	Clear	12	25	15	50
AND114S	Red	Red	Diffused	4	8	15	80
AND113G	Green	Green	Clear	15	30	15	50
AND114G	Green	Green	Diffused	4	8	15	80
AND113Y	Yellow	Yellow	Clear	10	20	15	50
AND114Y	Yellow	Yellow	Diffused	3	6	15	80
AND113O	Orange	Orange	Clear	10	20	15	50
AND114O	Orange	Orange	Diffused	3	6	15	80

AND113P and 114P Series - T1 $\frac{3}{4}$ Package - Standard Bright Flush Mount (No Standoffs)

Part Number	Color		Lens Description	Axial Luminous Intensity (mcd)		Test Condition (I _F -mA)	Viewing Angle 2 θ $\frac{1}{2}$ (deg)
	Led	Lens		Min.	Typ.		
AND113RP	Red	Red	Clear	3.5	7	15	50
AND114RP	Red	Red	Diffused	1.5	3	15	80
AND113GP	Green	Green	Clear	15	30	15	50
AND114GP	Green	Green	Diffused	4	8	15	80
AND113YP	Yellow	Yellow	Clear	10	20	15	50
AND114YP	Yellow	Yellow	Diffused	3	6	15	80
AND113OP	Orange	Orange	Clear	10	20	15	50
AND114OP	Orange	Orange	Diffused	3	6	15	80

AND123 and 124 Series - T1 Package - Standard Bright

Part Number	Color		Lens Description	Axial Luminous Intensity (mcd)		Test Condition (I _F -mA)	Viewing Angle 2 θ $\frac{1}{2}$ (deg)
	Led	Lens		Min.	Typ.		
AND123R	Red	Red	Clear	1.5	3.5	10	60
AND124R	Red	Red	Diffused	1	2.5	10	70
AND123G	Green	Green	Clear	5	10	10	60
AND124G	Green	Green	Diffused	2.5	5	10	70
AND123Y	Yellow	Yellow	Clear	2.5	5	10	60
AND124Y	Yellow	Yellow	Diffused	2	4	10	70



LED Lamps

STANDARD BRIGHT

T1¾

AND113(P) Series
AND114(P) Series

T1

AND163 Series
AND164 Series
AND123 Series
AND124 Series

AND163 and 164 Series - T1 Package - Standard Bright

Part Number	Color		Lens Description	Axial Luminous Intensity (mcd)		Test Condition (I _F -mA)	Viewing Angle 2θ½ (deg)
	Led	Lens		Min.	Typ.		
AND163S	Red	Red	Clear	20	40	20	10
AND164S	Red	Red	Diffused	10	20	20	25
AND163G	Green	Green	Clear	15	30	20	10
AND164G	Green	Green	Diffused	7.5	15	20	25
AND163Y	Yellow	Yellow	Clear	10	20	20	10
AND164Y	Yellow	Yellow	Diffused	5	10	20	25
AND163O	Orange	Orange	Clear	20	40	20	10
AND164O	Orange	Orange	Diffused	10	20	20	25

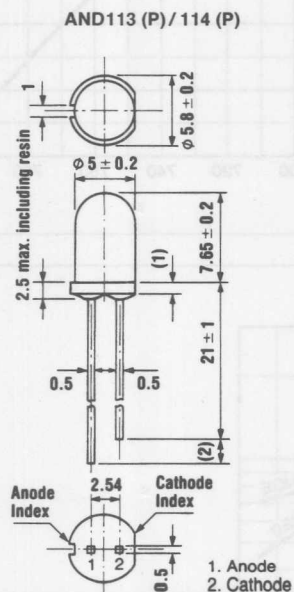
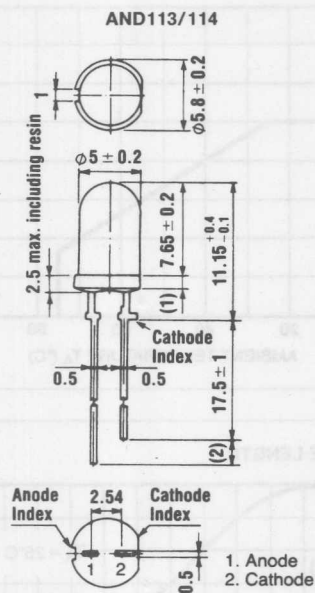
Absolute Maximum Ratings (T_A = 25°C)

Characteristics	Symbol	Rating				Unit
		Red	Green	Yellow	Orange	
Forward Current (DC)						
AND113/114(P), AND123/124	I _F	20	25	25	25	mA
AND163/164	I _F	25	25	25	25	mA
AND113S/114S	I _F	25	—	—	—	mA
Reverse Voltage	V _R	4	4	4	4	V
Power Dissipation						
AND113/114(P) Series	P _D	65	70	70	70	mW
AND163/164 Series	P _D	70	70	70		mW
AND123/124 Series	P _D	65	70	70		mW
AND113S/114S	P _D	70	—	—	—	mW
Operating Temperature Range	T _{OPR}	—20 to +75				°C
Storage Temperature Range	T _{STG}	—30 to +100				°C

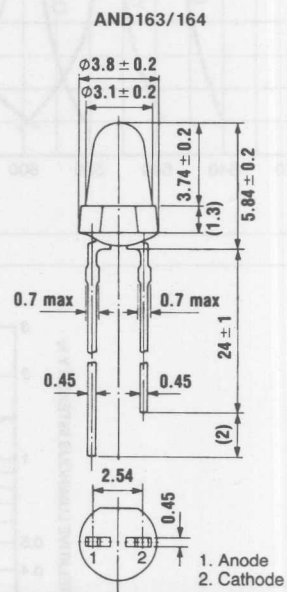
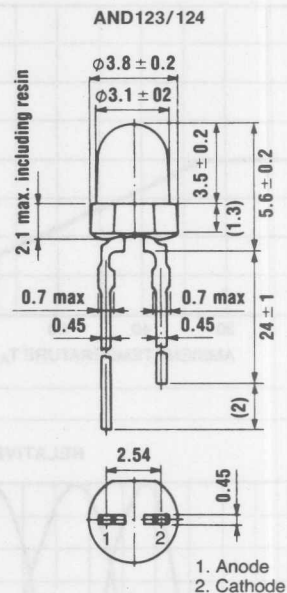
Electro-Optical Characteristics (T_A = 25°C)

Characteristics	Symbol	Test Condition	Red			Green			Yellow			Orange			Units
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Forward Voltage	V _F	I _F = 20mA		2.1	2.8		2.1	2.8		2.1	2.8		2.1	2.8	V
Reverse Current	I _R	V _R = 4V			5			5			100			100	μA
Peak Emission Wavelength															
AND113/114(P), AND123/124	λ _P	I _F = 15mA			700		565			585			610		nm
AND163/164, 113S/114S	λ _P	I _F = 15mA		635			565			585			610		nm
Spectral Line Half Width															
AND113/114(P), AND123/124	Δλ	I _F = 15mA			100		25			32			35		nm
AND163/164, 113S/114S	Δλ	I _F = 15mA		40			25			32			35		nm

Outline Dimension (in millimeters)



Outline Dimension (in millimeters)





LED Lamps

STANDARD BRIGHT

T1^{3/4}

AND113(P) Series

AND114(P) Series

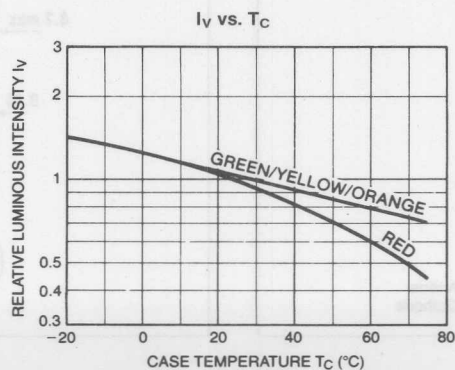
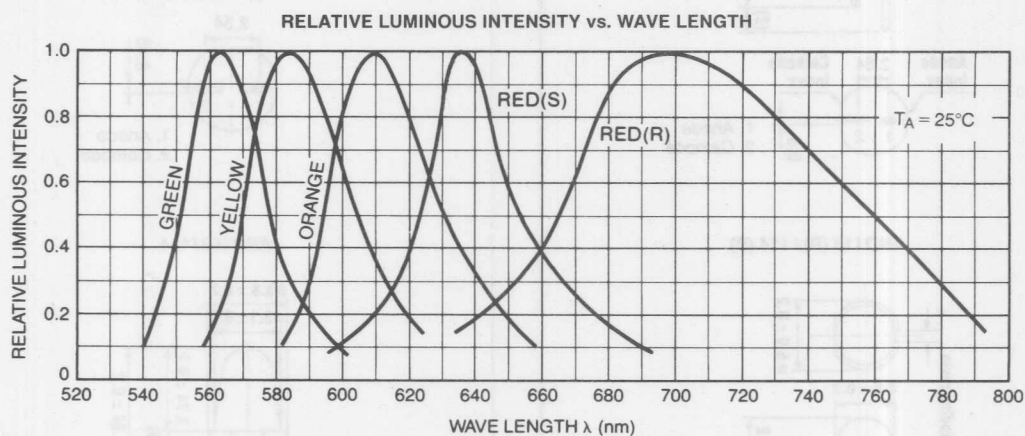
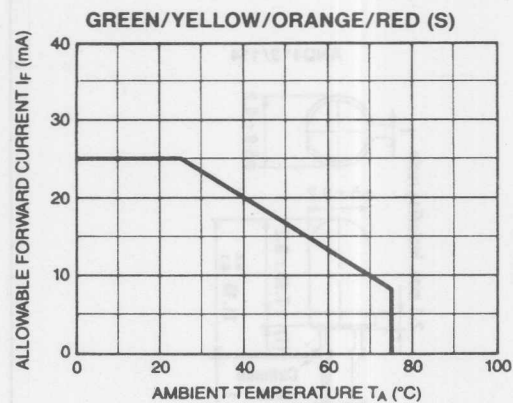
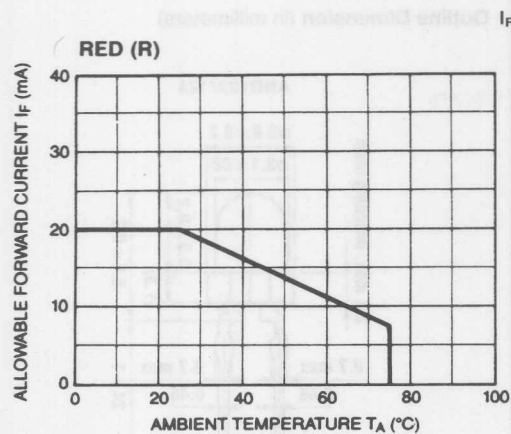
AND123 Series

AND124 Series

T1

AND163 Series

AND164 Series





LED Lamps

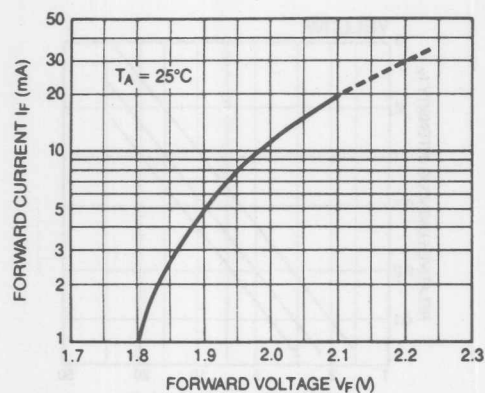
STANDARD BRIGHT

T1^{3/4}AND113(P) Series
AND114(P) Series

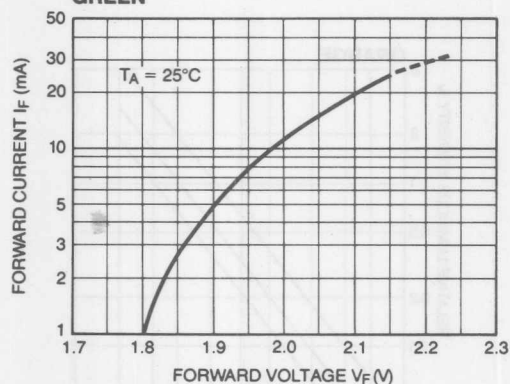
T1

AND163 Series
AND164 Series
AND123 Series
AND124 Series

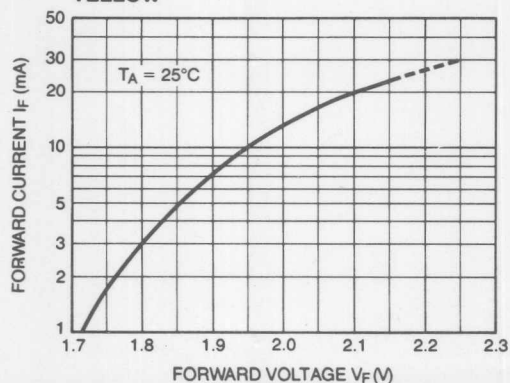
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 I_F vs. V_F 

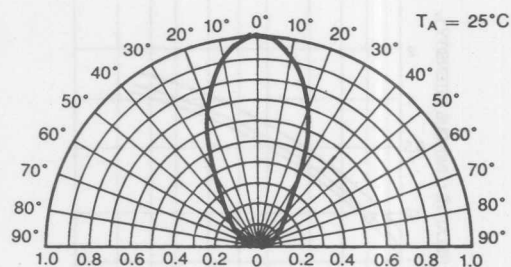
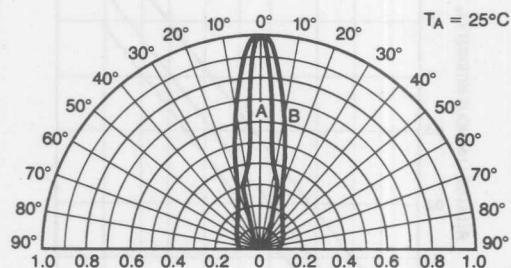
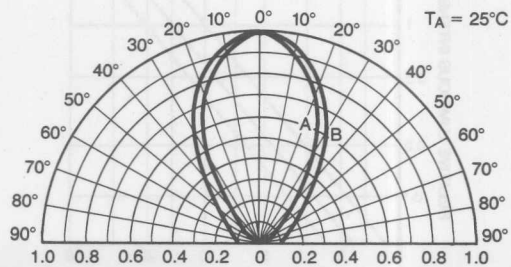
GREEN



YELLOW



Radiation Pattern

A: AND113(P)
B: AND114(P)A: AND163
B: AND164A: AND123
B: AND124

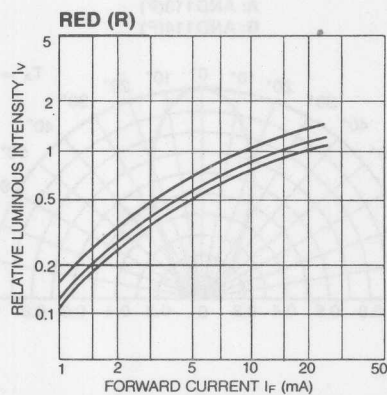


LED Lamps

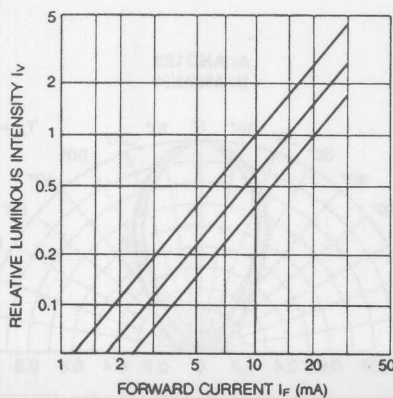
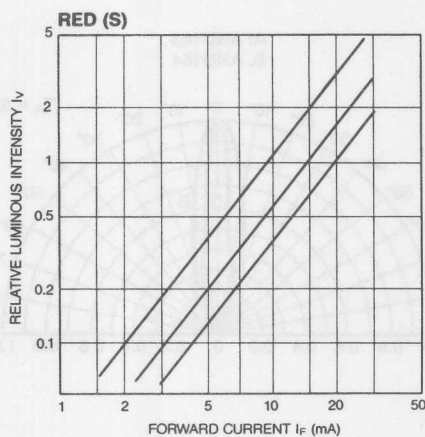
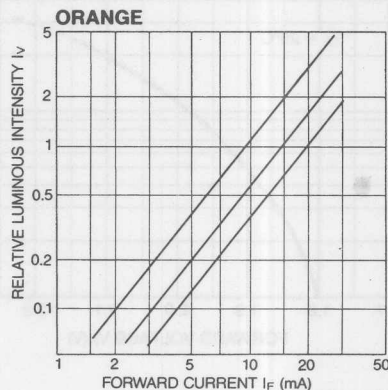
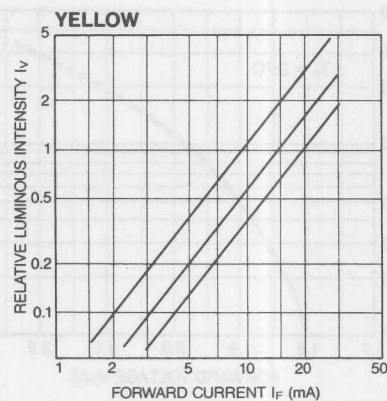
STANDARD BRIGHT

T1^{3/4}AND113(P) Series
AND114(P) Series

T1

AND123 Series
AND124 Series
AND163 Series
AND164 Series I_V vs. I_F 

(This graph shows relative luminous intensity vs. forward current.
At three points ($I_F = 10, 15, 20$ mA) each relation is normalized.)

 I_V vs. V_F 



LED Lamps

ULTRA BRIGHT

T1 $\frac{3}{4}$ AND181P Series
AND182P Series

T1

AND163U Series
AND164U Series

FEATURES

- Ultra Bright
- Low drive current
- Solid state reliability, long life
- Excellent ON-OFF contrast ratio
- Fast response time, capable of pulse drive
- Choice of 4 colors
 - GaAlAs-red (UR, RC)
 - GaP-red (R)
 - GaP-green
 - GaAsP-red (S)
 - GaAsP-yellow
 - GaAsP-Orange

1

AND181P and 182P Series - T1 $\frac{3}{4}$ Package Ultra Bright

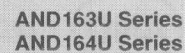
Part Number	Color		Lens Description	Axial Luminous Intensity (mcd)		Test Condition (I _F -mA)	Viewing Angle 2 θ $\frac{1}{2}$ (deg)
	Led	Lens		Min.	Typ.		
AND181RCP	Red	Red	Clear	250	500	20	15
AND182RCP	Red	Red	Diffused	150	300	20	25
AND181URP	Red	LT Red	Clear	125	250	20	15
AND182URP	Red	LT Red	Diffused	75	150	20	25
AND181SP	Red	LT Red	Clear	75	150	20	15
AND182SP	Red	LT Red	Diffused	45	90	20	25
AND181RP	Red	LT Red	Clear	25	50	20	15
AND182RP	Red	LT Red	Diffused	13	25	20	25
AND181GP	Green	LT Green	Clear	100	200	20	15
AND182GP	Green	LT Green	Diffused	60	120	20	25
AND181YP	Yellow	LT Yellow	Clear	75	150	20	15
AND182YP	Yellow	LT Yellow	Diffused	45	90	20	25
AND181OP	Orange	LT Orange	Clear	75	150	20	15
AND182OP	Orange	LT Orange	Diffused	45	90	20	25

AND163U and 164U Series - T1 Package Ultra Bright

Part Number	Color		Lens Description	Axial Luminous Intensity (mcd)		Test Condition (I _F -mA)	Viewing Angle 2 θ $\frac{1}{2}$ (deg)
	Led	Lens		Min.	Typ.		
AND163UR	Red	LT Red	Clear	50	100	20	10
AND164UR	Red	LT Red	Diffused	20	40	20	25
AND163UG	Green	LT Green	Clear	35	70	20	10
AND164UG	Green	LT Green	Diffused	15	30	20	25
AND163UY	Yellow	LT Yellow	Clear	20	40	20	10
AND164UY	Yellow	LT Yellow	Diffused	10	20	20	25

Absolute Maximum Ratings (T_A = 25°C)

Characteristics	Symbol	Rating				Unit
		Red	Green	Yellow	Orange	
Forward Current (DC)	I _F	25	25	25	25	mA
Reverse Voltage	V _R	4	4	4	4	V
Power Dissipation	P _D	70	70	70	70	mW
Operating Temperature Range	T _{OPR}	-20 to +75				°C
Storage Temperature Range	T _{STC}	-30 to +100				°C

[illegible]

Technical drawing of a Cathode Index assembly. The drawing shows a top view and a side view.

Top View Dimensions:

- Outer diameter: 5.8 ± 0.2
- Inner diameter (hole): 1.5
- Mounting flange diameter: 1.5
- Mounting flange thickness: 1

Side View Dimensions:

- Total height: 9.65 ± 0.2
- Mounting flange thickness: 0.5
- Base thickness: 0.5
- Base diameter: 20 ± 1

Labels:

- Cathode Index**
- 1. Anode**
- 2. Cathode**

Technical drawing of a cathode for a vacuum tube, showing side and cross-sectional views with dimensions.

Side View Dimensions:

- Top diameter: $\varnothing 3.8 \pm 0.2$
- Inner diameter: $\varnothing 3.1 \pm 0.2$
- Distance from top to start of lead: 3.74 ± 0.2
- Lead diameter: (1.3)
- Total height: 5.84 ± 0.2
- Distance between lead centers: 0.7 max
- Lead thickness: 0.45
- Distance from base to lead center: 24 ± 1
- Base diameter: (2)

Cross-sectional View Dimensions:

- Base diameter: 2.54
- Lead thickness: 0.45
- Lead width: 0.45
- Lead positions: 1 (Anode), 2 (Cathode)

1. Anode
2. Cathode



LED Lamps

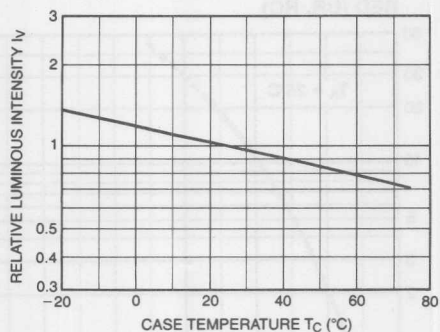
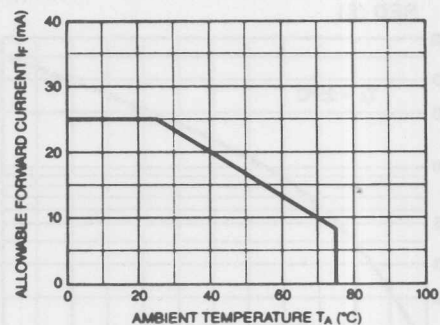
ULTRA BRIGHT

T1 $\frac{3}{4}$ AND181P Series
AND182P Series

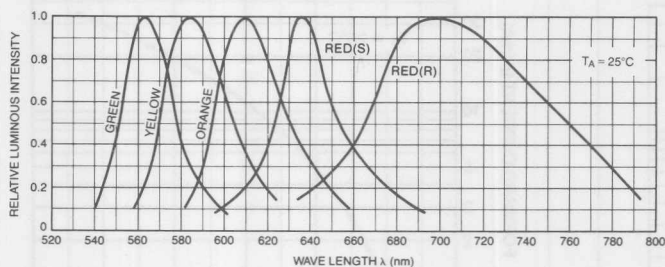
T1

AND163U Series
AND164U Series

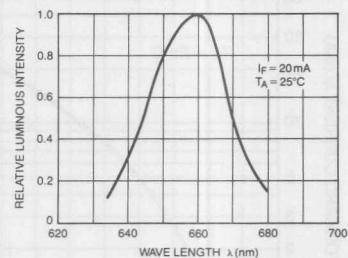
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 I_V vs. T_C  I_F vs. T_A 

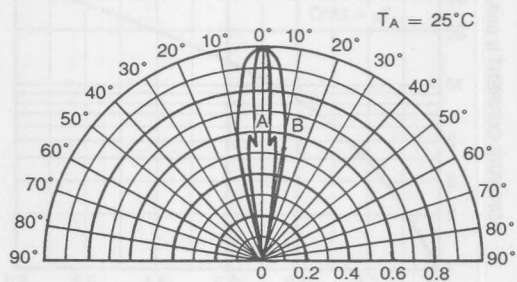
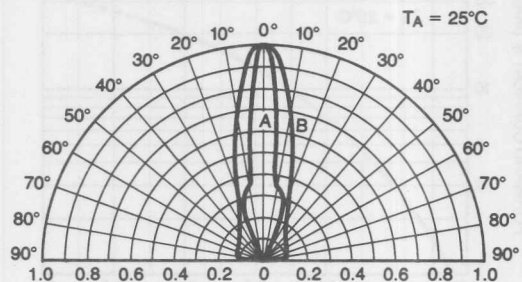
RELATIVE LUMINOUS INTENSITY vs. WAVE LENGTH

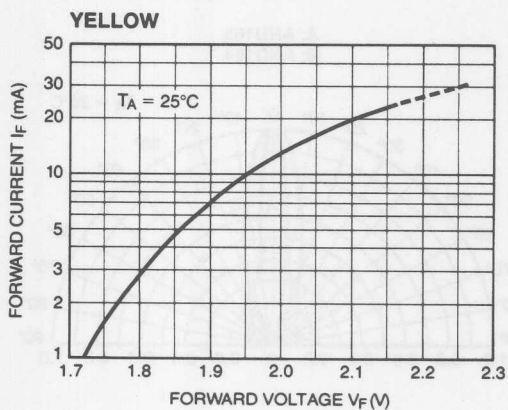
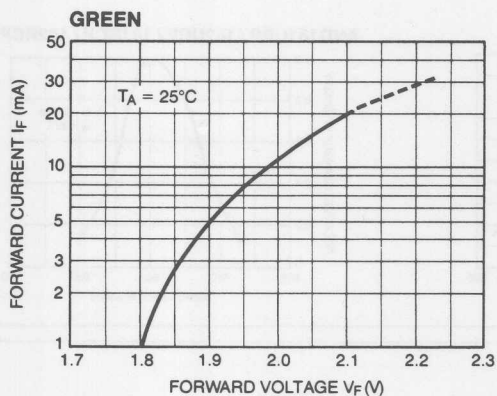
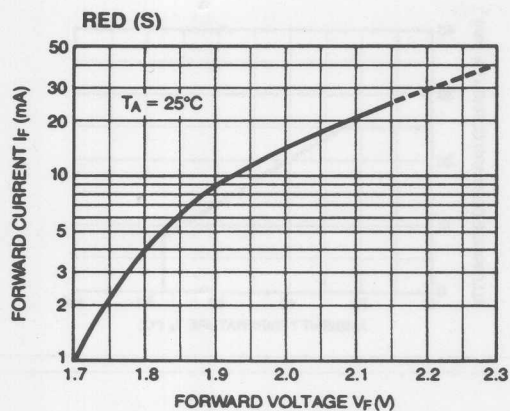
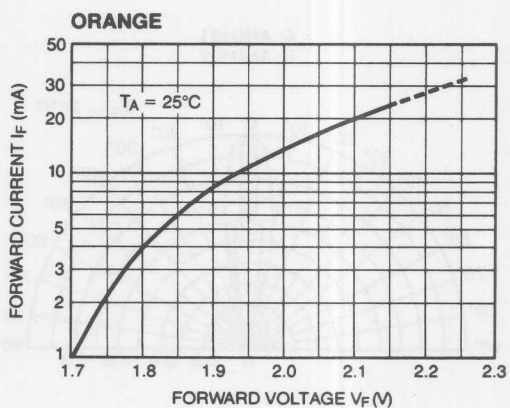
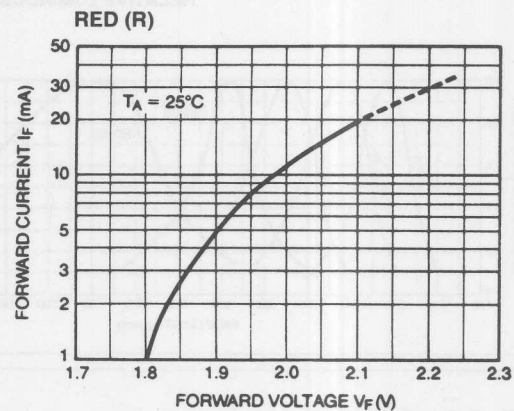
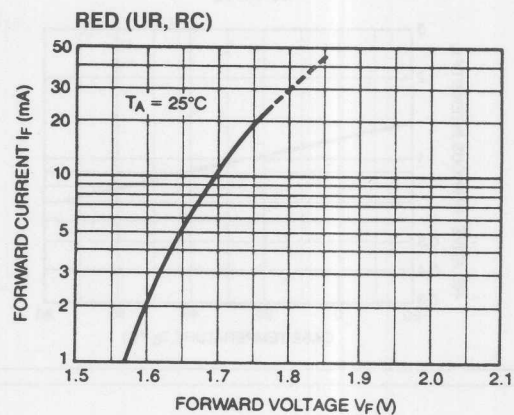


AND181URP / 182URP / 181RCP / 182RCP

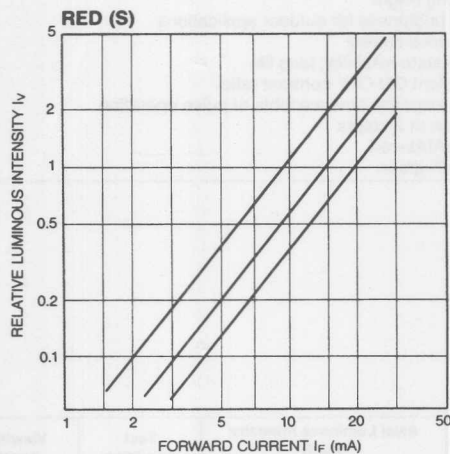


Radiation Pattern

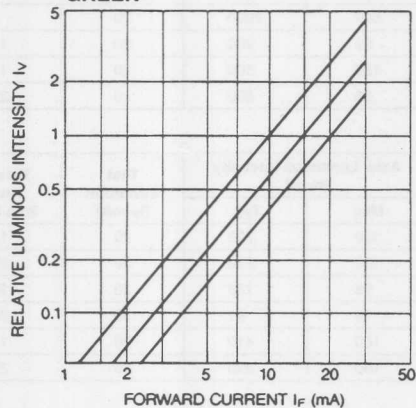
A: AND181
B: AND182A: AND163
B: AND164

 I_F vs. V_F  I_V vs. I_F 

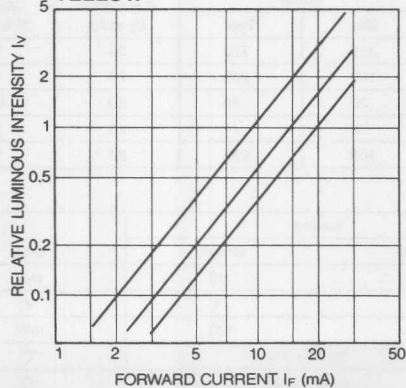
I_F vs. V_F



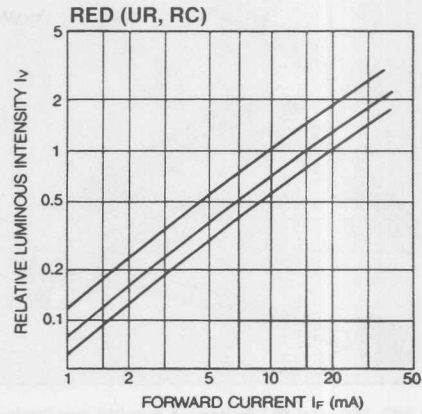
GREEN



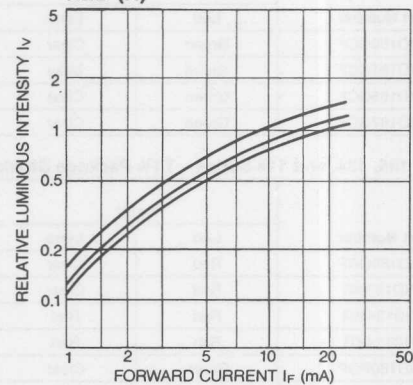
YELLOW



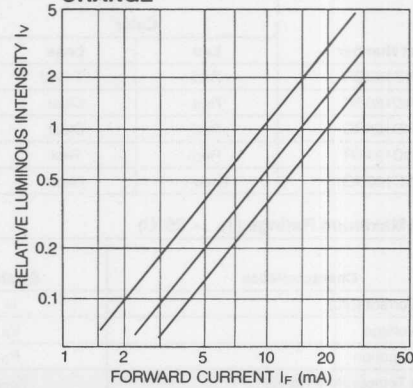
I_v vs. I_F



RED (R)

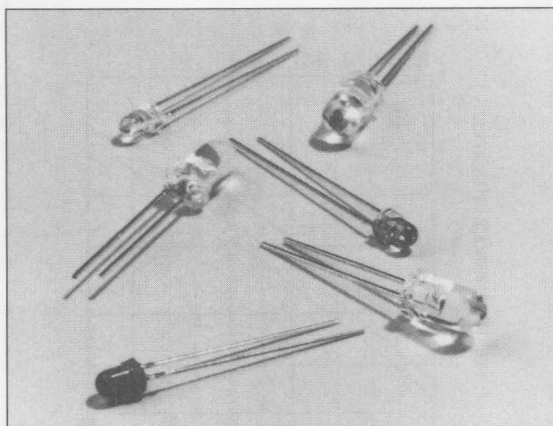


ORANGE





LED Lamps STRIKING BRIGHT



FEATURES

- Striking Bright
- High brightness for outdoor applications
- Low drive current
- Solid state reliability, long life
- Excellent ON-OFF contrast ratio
- Fast response time, capable of pulse operation
- Choice of 2 colors
 - GaAlAs-red
 - GaP-green

AND185, 187, 190, and 191 Series – 8 mm / 10 mm Package Striking Bright

Part Number	Color		Lens Description	Axial Luminous Intensity (mcd)		Test Condition (I _F -mA)	Viewing Angle 2θ½ (deg)
	Led	Lens		Min.	Typ.		
AND190GCP	Green	Clear	Clear	560	2000	20	4
AND191GCP	Green	Milky	Diffused	56	200	20	16
AND185GCP	Green	Clear	Clear	180	500	20	15
AND187GCP	Green	Clear	Clear	56	200	20	24

AND180, 135, 134, and 114 Series – T1¾ Package Striking Bright

Part Number	Color		Lens Description	Axial Luminous Intensity (mcd)		Test Condition (I _F -mA)	Viewing Angle 2θ½ (deg)
	Led	Lens		Min.	Typ.		
AND180QRP	Red	Clear	Clear	320	720	20	15
AND135NR	Red	Clear	Clear	100	230	20	25
AND134MR	Red	Red	Diffused	56	128	20	30
AND114KR	Red	Red	Diffused	18	41	20	80
AND180PGP	Green	Clear	Clear	180	410	20	15
AND135NGP	Green	Clear	Clear	100	230	20	25

AND163, 124, 160 & 125 Series – T1 Package Striking Bright

Part Number	Color		Lens Description	Axial Luminous Intensity (mcd)		Test Condition (I _F -mA)	Viewing Angle 2θ½ (deg)
	Led	Lens		Min.	Typ.		
AND163QR	Red	LT Red	Clear	320	720	20	10
AND160RC	Red	Clear	Clear	100	200	20	10
AND125RC	Red	Clear	Clear	25	50	20	60
AND124KR	Red	Red	Diffused	18	41	20	70
AND160NG	Green	Clear	Clear	100	230	20	10

Absolute Maximum Ratings (T_A = 25°C)

Characteristics	Symbol	Rating		Unit
		Red	Green	
Forward Current (DC)	I _F	25	40	mA
Reverse Voltage	V _R	4	4	V
Power Dissipation	P _D	55	120	mW
Operating Temperature Range	T _{OPR}	– 20 to + 75		°C
Storage Temperature Range	T _{STC}	– 30 to + 100		°C

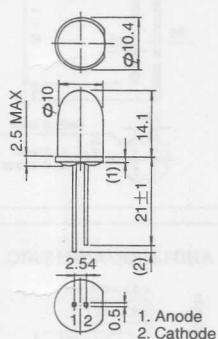


Electro-Optical Characteristics ($T_A = 25^\circ\text{C}$)

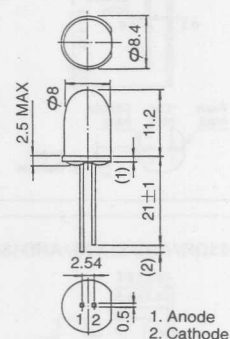
Characteristics	Symbol	Test Condition	Red			Green			Units
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Forward Voltage	V_F	$I_F = 20\text{mA}$		1.75	2.2		2.1	2.8	V
Reverse Current	I_R	$V_R = 4\text{V}$			100			5	μA
Peak Emission Wavelength	λ_P	$I_F = 15\text{mA}$		660			565		nm
Spectral Line Half Width	$\Delta\lambda$	$I_F = 15\text{mA}$		25			25		nm

1

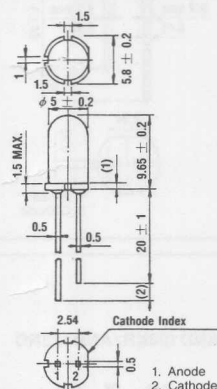
AND190 / 191



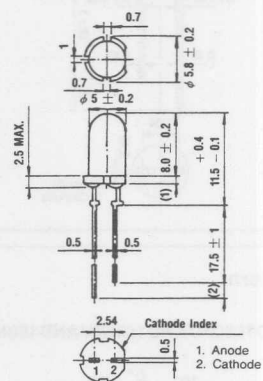
AND185 / 187

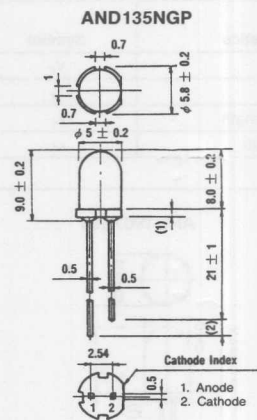
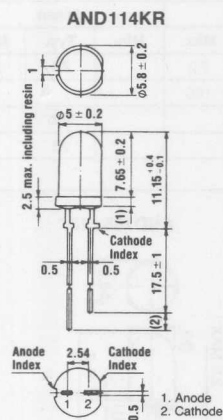


AND180QRP/AND180PGP

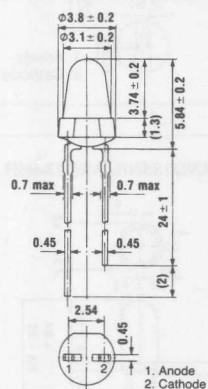


AND135NR/AND134MR

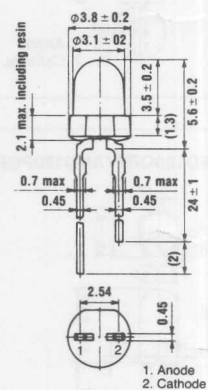




AND163QR/AND160NG/AND160RC

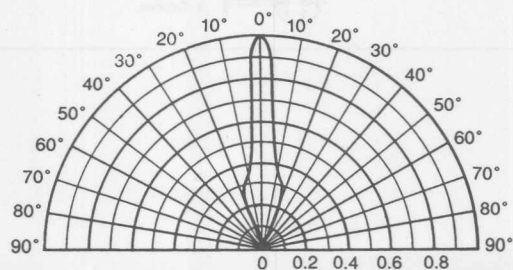


AND124KR/AND125RC

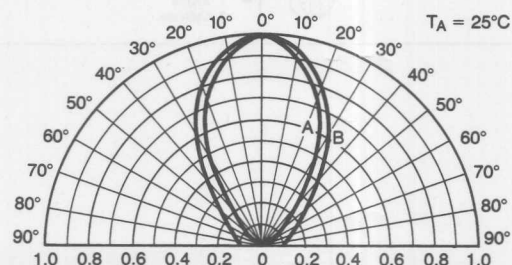


Radiation Pattern

AND163QR/AND160RC/AND160NG



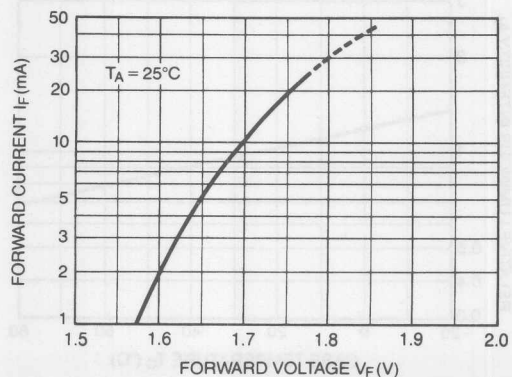
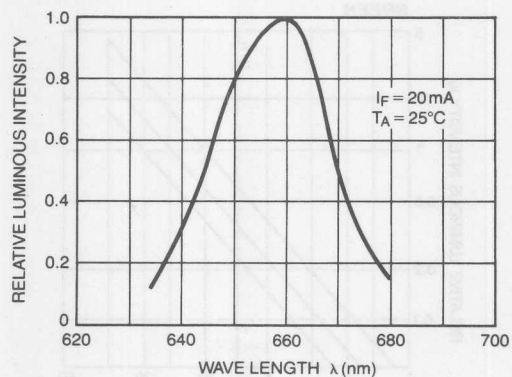
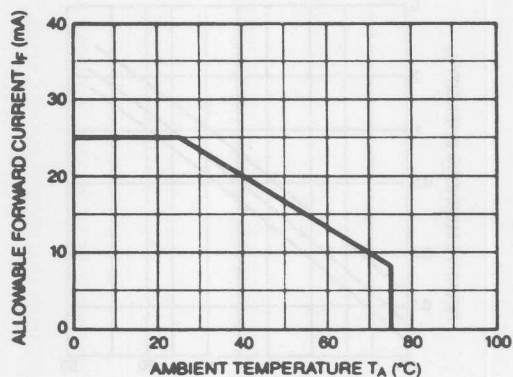
AND124KR/AND125RC





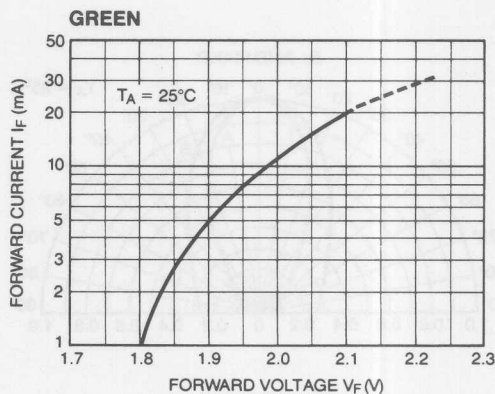
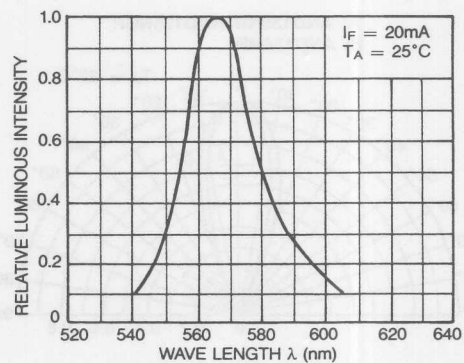
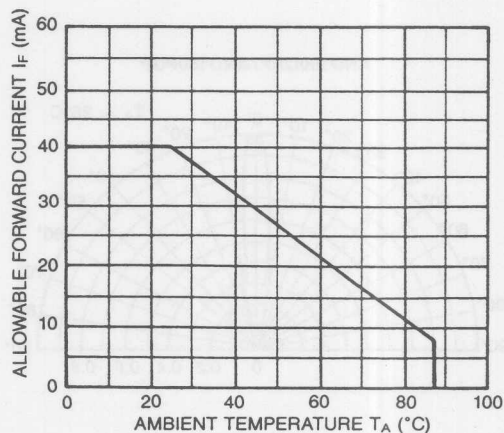
Red

$I_F - T_A$



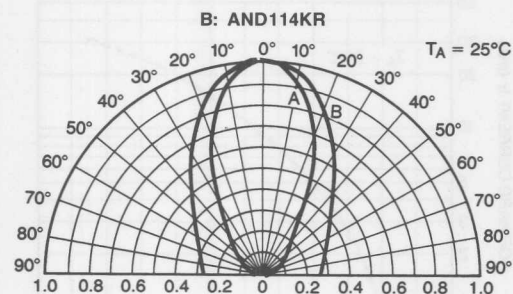
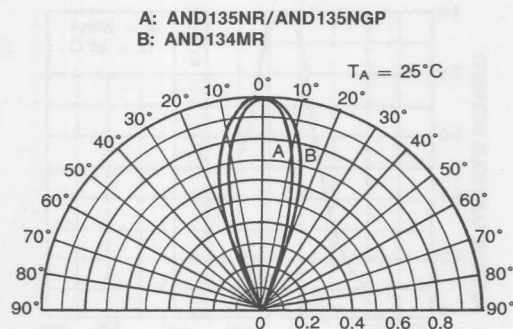
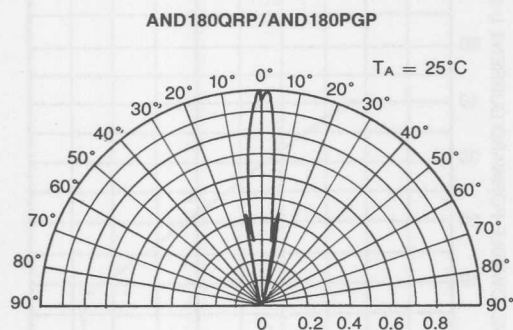
Green

$I_F - T_A$

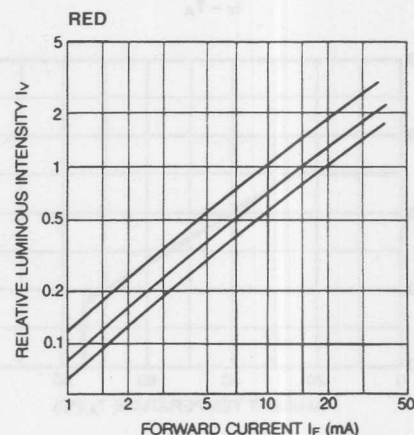




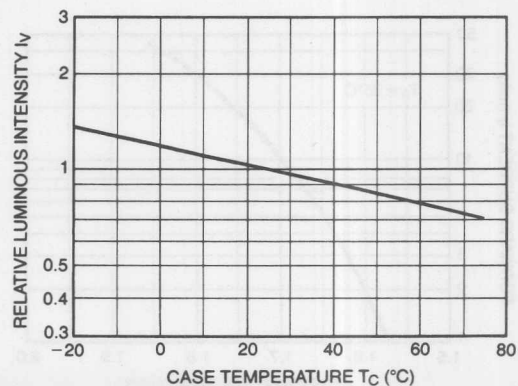
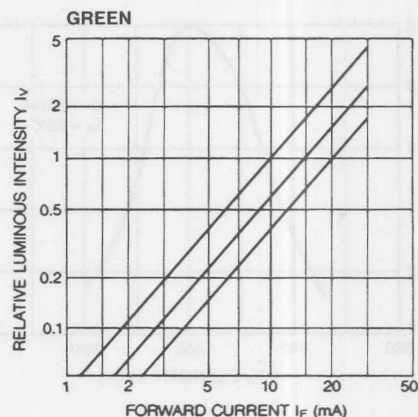
Radiation Pattern



$I_V - I_F$

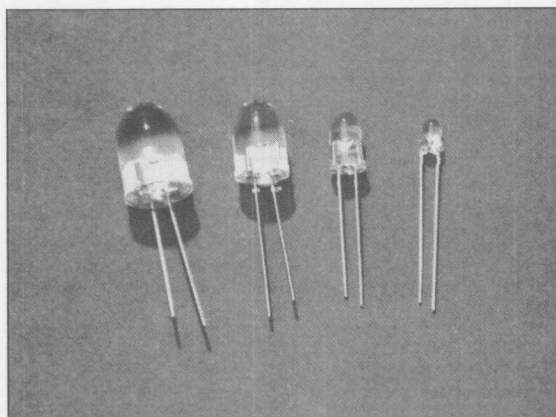


(This graph shows relative luminous intensity vs. forward current. At three points ($I_F = 10, 15, 20\text{mA}$) each relation is normalized.)





LED Lamps KILO BRIGHT



FEATURES

- Double hetero structure
GaAlAs-red
- High brightness for outdoor applications
- Low drive current
- Solid state reliability, long life
- Excellent ON-OFF contrast ratio
- Fast response time, capable of pulse drive

1

AND185, 187, 190, and 191 Series - 8 mm / 10 mm Package Kilo Bright

Part Number	Color		Lens Description	Axial Luminous Intensity (mcd)		Test Condition (I _F -mA)	Viewing Angle 2θ _{1/2} (deg)
	Led	Lens		Min.	Typ.		
AND190CRP	Red	Clear	Clear	5600	13000	20	4
AND190BRP	Red	Clear	Clear	3200	7200	20	4
AND191CRP	Red	Milky	Diffused	320	720	20	16
AND191BRP	Red	Milky	Diffused	180	410	20	16
AND185ARP	Red	Clear	Clear	1800	3000	20	15
AND187ARP	Red	Clear	Clear	320	1000	20	24

AND120, 130, 155, 180, 134, and 116 Series - T1^{3/4} Package Kilo Bright

Part Number	Color		Lens Description	Axial Luminous Intensity (mcd)		Test Condition (I _F -mA)	Viewing Angle 2θ _{1/2} (deg)
	Led	Lens		Min.	Typ.		
AND180CRP	Red	Clear	Clear	1800	4100	20	8
AND180BRP	Red	Clear	Clear	1000	2300	20	8
AND180ASP	Red	Clear	Clear	320	1000	20	8
AND130CR	Red	Clear	Clear	1000	2300	20	15
AND130BR	Red	Clear	Clear	560	1280	20	15
AND155CRP	Red	Clear	Clear	560	1280	20	24
AND155BRP	Red	Clear	Clear	320	720	20	24
AND155ASP	Red	Clear	Clear	153	300	20	24
AND120CR	Red	Clear	Clear	560	1280	20	35
AND120BR	Red	Clear	Clear	320	720	20	35
AND134CR	Red	Red	Diffused	100	230	20	35
AND134BR	Red	Red	Diffused	56	208	20	35
AND116CR	Red	Milky	Diffused	56	208	20	60
AND116BR	Red	Milky	Diffused	32	72	20	60

AND125 and 126 Series - T1 Package Kilo Bright

Part Number	Color		Lens Description	Axial Luminous Intensity (mcd)		Test Condition (I _F -mA)	Viewing Angle 2θ _{1/2} (deg)
	Led	Lens		Min.	Typ.		
AND125CR	Red	Clear	Clear	160	400	20	60
AND126CR	Red	Milky	Diffused	63	150	20	70



AND125 and 126 Series - T1 Package Kilo Bright Low Current

Part Number	Color		Lens Description	Axial Luminous Intensity (mcd)		Test Condition (I_F -mA)	Viewing Angle $2\theta_{1/2}$ (deg)
	Led	Lens		Min.	Typ.		
AND125CR (0.5 mA)	Red	Clear	Clear	—	4.0	0.5	60
AND126CR (0.5 mA)	Red	Milky	Diffused	—	2.0	0.5	70

Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$)

Characteristics	Symbol	Rating	Unit
		Red	
Forward Current (DC)	I_F	50	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	125	mW
Operating Temperature Range	T_{OPR}	-20 to +85	$^\circ\text{C}$
Storage Temperature Range	T_{STG}	-30 to +100	$^\circ\text{C}$

AND 180ASP / AND155ASP

Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$)

Characteristics	Symbol	Rating	Unit
		Red	
Forward Current (DC)	I_F	50	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	125	mW
Operating Temperature Range	T_{OPR}	-20 to +85	$^\circ\text{C}$
Storage Temperature Range	T_{STG}	-30 to +100	$^\circ\text{C}$

Electro-Optical Characteristics ($T_A = 25^\circ\text{C}$)

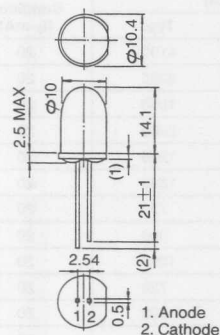
Characteristics	Symbol	Test Condition	Red			Units
			Min.	Typ.	Max.	
Forward Voltage	V_F	$I_F = 20\text{mA}$	1.75	2.2		V
Reverse Current	I_R	$V_R = 4\text{V}$			100	μA
Peak Emission Wavelength	λ_P	$I_F = 20\text{mA}$	660			nm
Spectral Line Half Width	$\Delta\lambda$	$I_F = 20\text{mA}$	25			nm

AND180ASP / AND155ASP

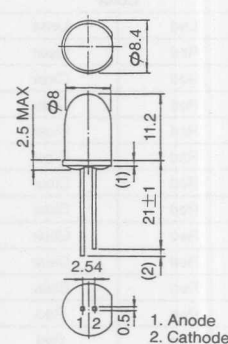
Electro-Optical Characteristics ($T_A = 25^\circ\text{C}$)

Characteristics	Symbol	Test Condition	Red			Units
			Min.	Typ.	Max.	
Forward Voltage	V_F	$I_F = 20\text{mA}$	1.9	2.4		V
Reverse Current	I_R	$V_R = 4\text{V}$			100	μA
Peak Emission Wavelength	λ_P	$I_F = 20\text{mA}$	630			nm
Spectral Line Half Width	$\Delta\lambda$	$I_F = 20\text{mA}$	25			nm

AND190 / 191

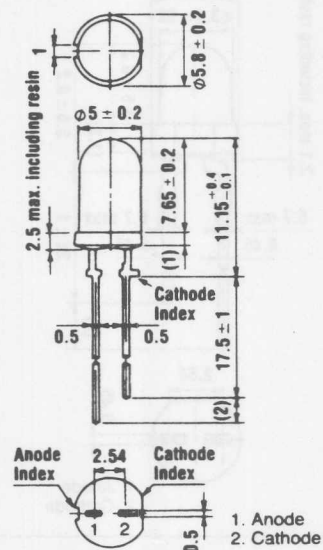


AND185 / 187

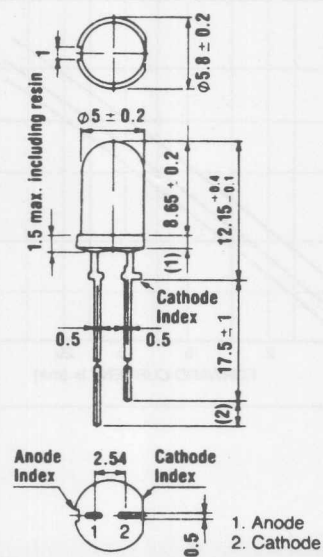


Outline Dimension (in millimeters)

AND120 Series/AND116 Series

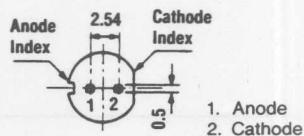
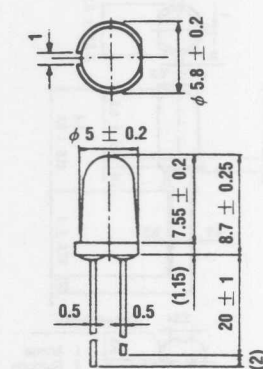


AND130 Series

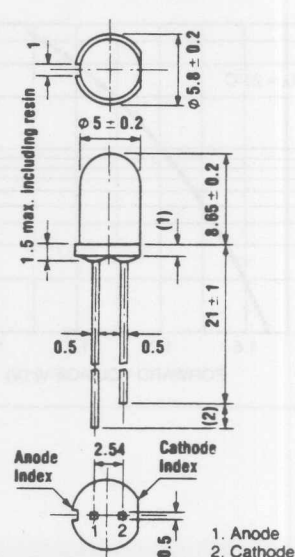


Outline Dimension (in millimeters)

AND155 Series

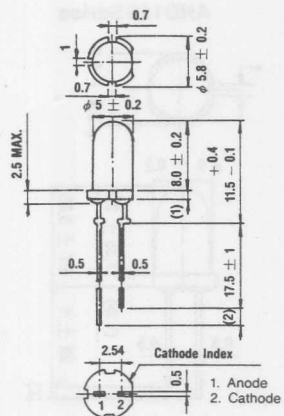


AND180 Series

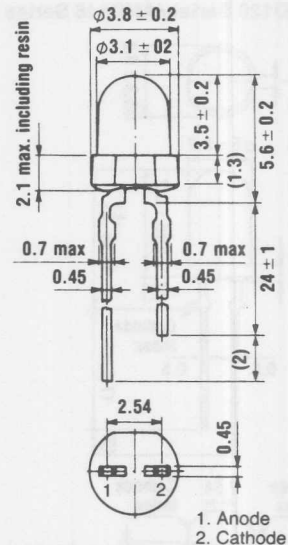


Outline Dimension (in millimeters)

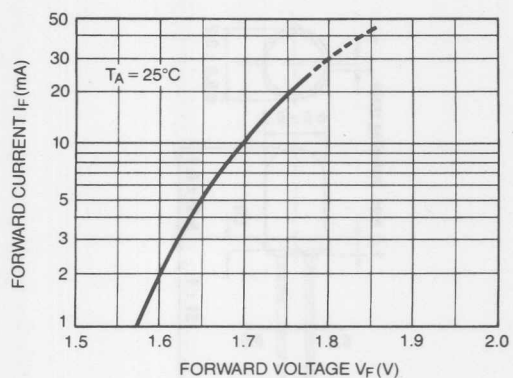
AND134 Series



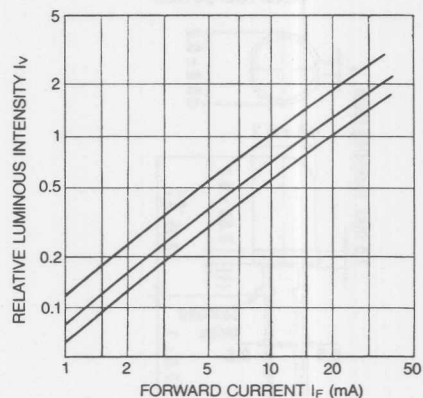
AND125 / 126 Series

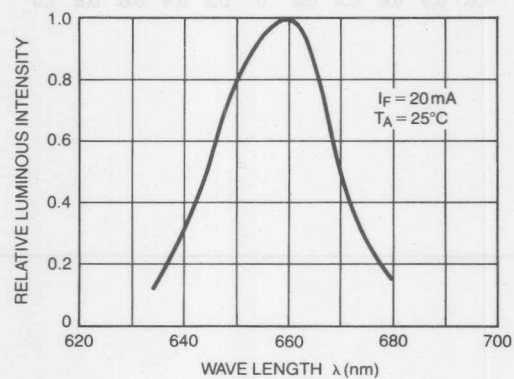
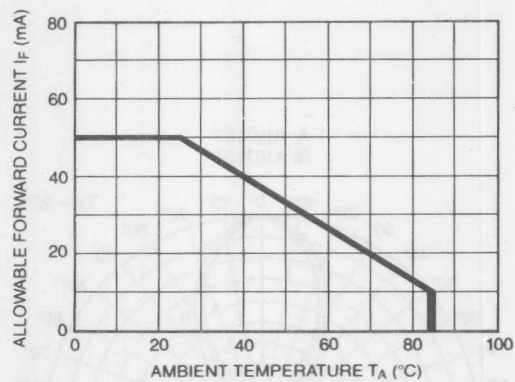
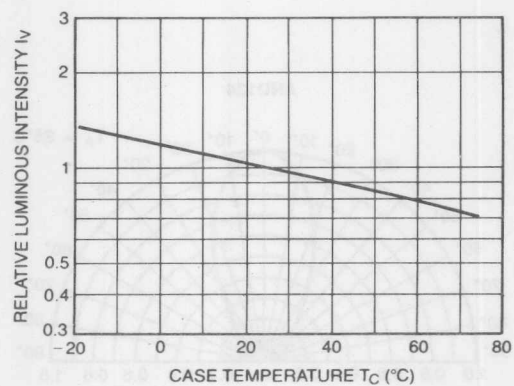


$I_F - V_F$

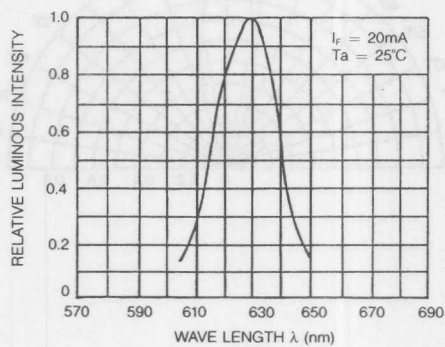
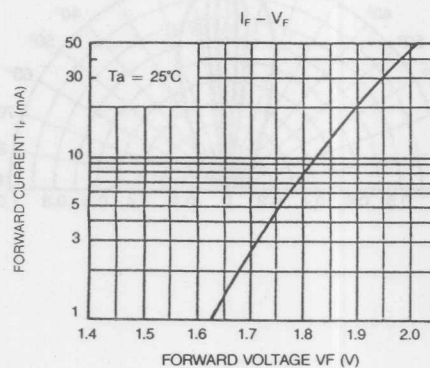


$I_V - I_F$



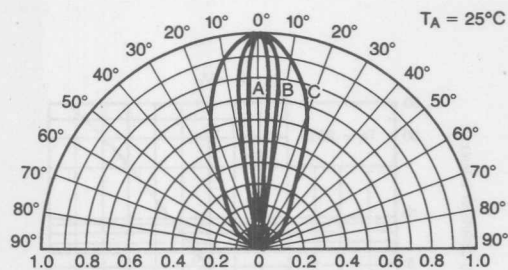


AND180ASP / AND155ASP

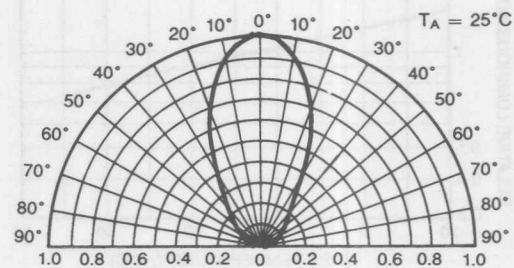




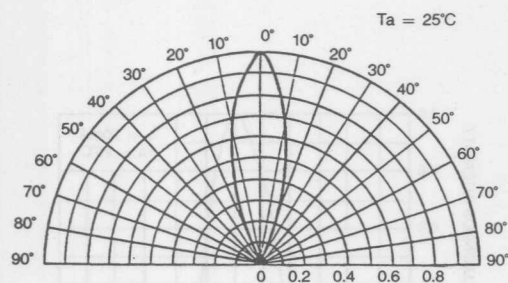
A: AND180
B: AND130
C: AND120/116



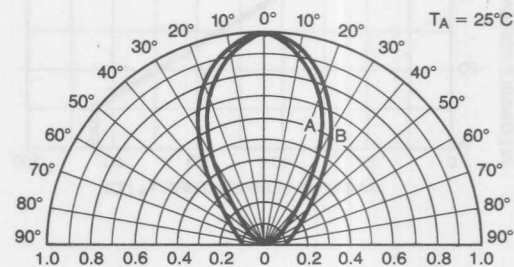
AND134

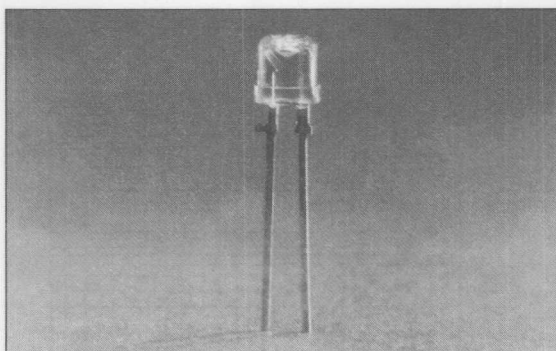


AND155



A: AND125
B: AND126





Fiber Optic Emitter Series

Part Number	Fiber Coupled Power (dBm)	Test Condition (mA)	Forward Voltage (V)	Cut-Off Frequency (MHz)	Total Capacitance (pF)
AND280R	-4.0	30	1.9	3	80
AND281R	-4.0	30	1.9	3	80

Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$)

Characteristics	Symbol	Rating	Unit
Power Dissipation	P_D	130	mW
Forward Current (DC)	I_F	50	mA
Forward Current (Pulse)*	I_{FP}	200	mA
Reverse Voltage	V_R	4	V
Operating Temperature Range	T_{OPR}	-30 to +85	$^\circ\text{C}$
Storage Temperature Range	T_{STG}	-40 to +90	$^\circ\text{C}$

*Pulse Width = 1msec., Duty = 1/20

Electro-Optical Characteristics ($T_A = 25^\circ\text{C}$)

Characteristics	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Fiber Coupled Power (Note)	P_F	$I_F = 30\text{mA}$	-7.0	-4.0	-	dBm
			200	400	-	μW
Reverse Current	I_R	$V_R = 4\text{V}$			100	μA
Forward Voltage	V_F	$I_F = 30\text{mA}$		1.9	2.5	V
Peak Emission Wavelength	λ_P	$I_F = 30\text{mA}$		660		nm
Spectral Line Half Width	$\Delta\lambda$	$I_F = 30\text{mA}$		25		nm
Total Capacitance	C_T	$V = 0\text{V}$, $f = 1\text{MHz}$		80		pF
Cutoff Frequency	f_c	$I_F = 30\text{mA}_{DC}$ $+ 6\text{mA}_{P-P}$ Output: 3dB down to 100kHz		3		MHz

Note: Using plastic fiber cable, Fiber length = 0.5m, Core Diameter = $980\mu\text{m}$, NA = 0.5 $P_F (\text{dBm}) = 10 \cdot \log [P (\mu\text{W}) / 1000 (\mu\text{W})]$

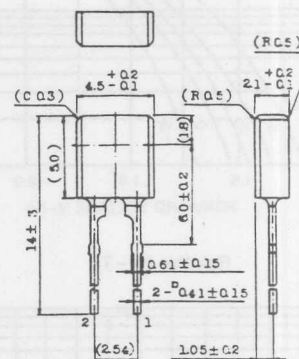
FEATURES

- 660 nm emitter optimized for plastic fiber cable
- High output power coupled into plastic fiber

1

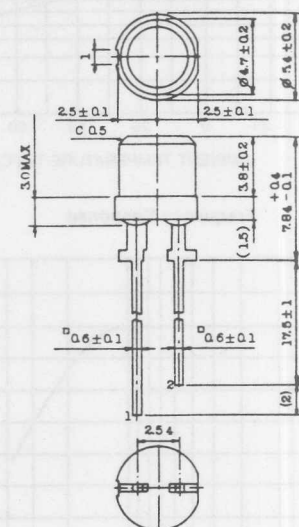
Outline Dimensions (in millimeters)

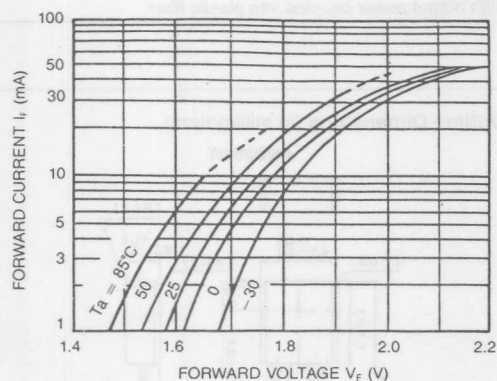
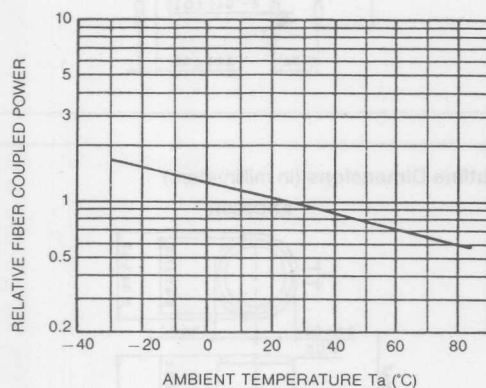
AND281R



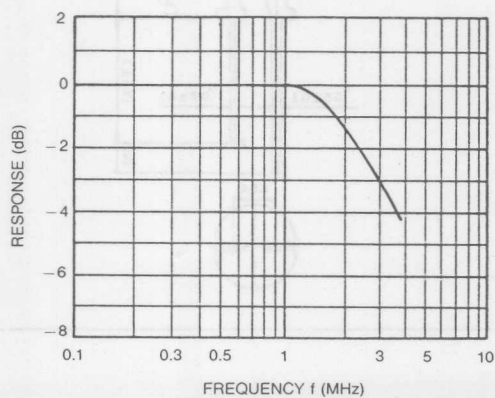
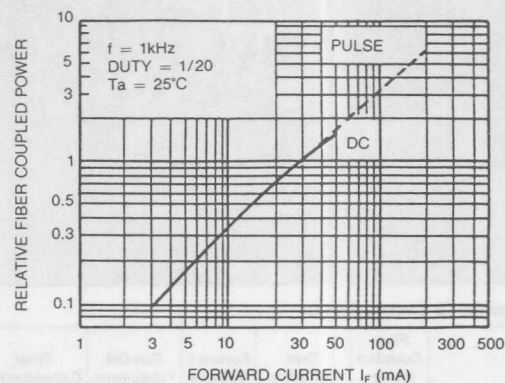
Outline Dimensions (in millimeters)

AND280R

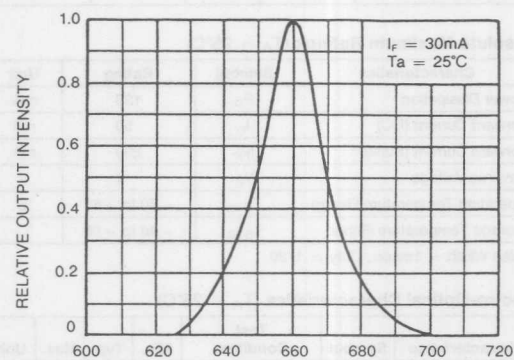
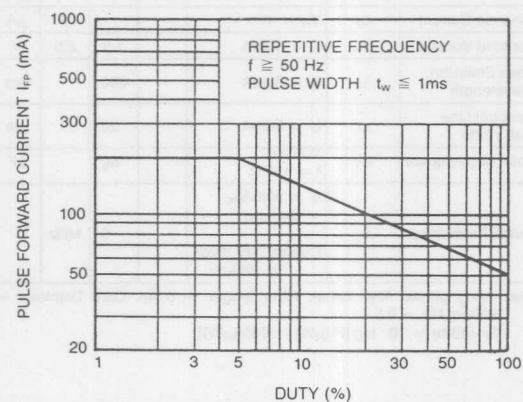


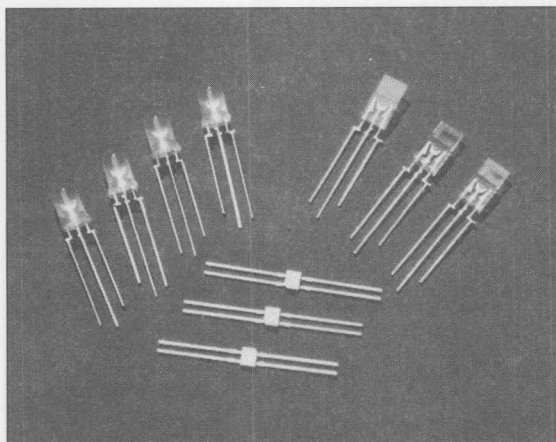
 $I_F - V_F$ Relative $P_F - T_a$ 

Frequency Response

Relative $P_F - I_F$ 

Emission Spectrum

 $I_{FP} - \text{Duty}$ 



FEATURES

- Dual color indicator
- Two color combinations
Red/Green
Yellow/Green
- Various shapes and sizes
- Low drive current
- Wide viewing angle

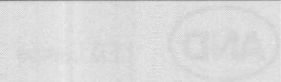
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Dual Color Series - Assorted Styles

Size	Part Number	Color Led	Lens	Lens Description	Axial Luminous Intensity (mcd)				Test Condition (I _F -mA)	Viewing Angle 20½ (deg)
					Red/Yellow		Green			
					Min.	Typ.	Min.	Typ.		
04	AND101RG	Red/Green	Milky	Diffused	0.5	.75	0.5	1.5	20	180
T1	AND126SG	Red/Green	Milky	Diffused	2.5	5	2.25	4.5	10	
T1¾	AND116SG	Red/Green	Milky	Diffused	1.5	7	1.5	5	15	80
	AND116YG	Yellow/Green	Milky	Diffused	1.5	5	1.5	5	15	80
2 Lead	AND171SG	Red/Green	Milky	Diffused	1.2	6.0	2.5	12.0	20	
T1¾	AND177RAG	Red/Green	Colorless	Clear	480	1200	80	170	20	22
T1¾	AND182SG	Red/Green	Milky	Diffused	5	15	2.5	12	20	
T1¾	AND187RAG	Red/Green	Colorless	Clear		900		150	20	48
1 x 5	AND205SG	Red/Green	Milky	Diffused	0.5	1.5	0.5	1.5	15	
2 Lead	AND2451RGL	Red/Green	Milky	Diffused	0.7	1.2	1.0	1.7	10	80
2 x 5	AND208SG	Red/Green	Milky	Diffused	0.5	1.5	0.5	1.5	15	
	AND208YG	Yellow/Green	LT-Yellow	Diffused	0.5	1.5	0.5	1.5	15	
2.2 x 2.9	AND222SG	Red/Green	Clear	Clear		6		9	15	100
Flat Top	AND264SG	Red/Green	Milky	Diffused	1.5	5	1.5	5	15	

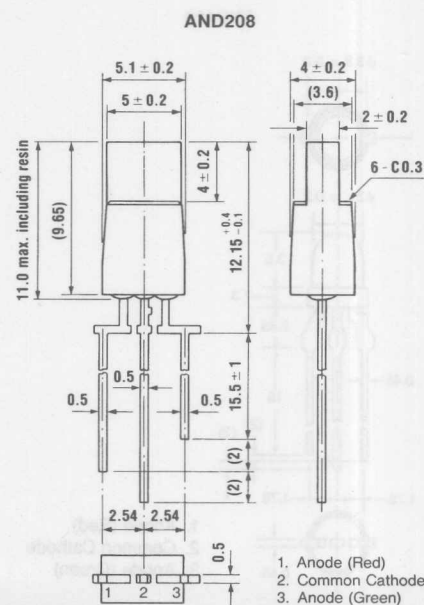
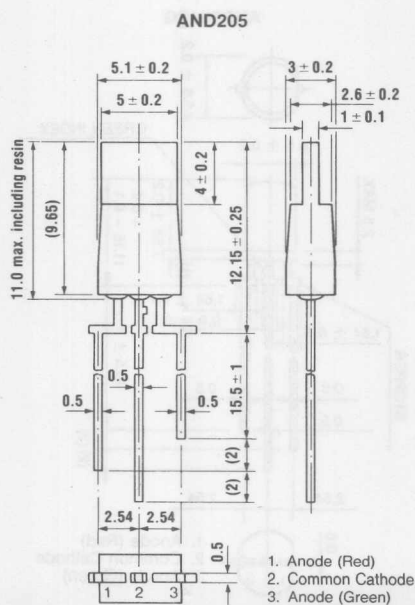
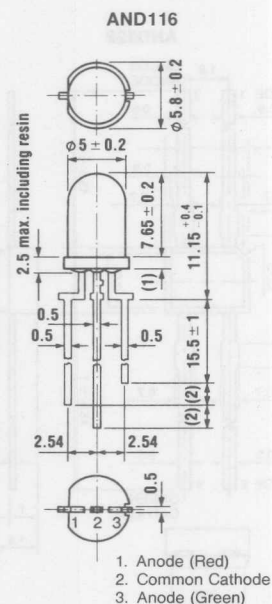
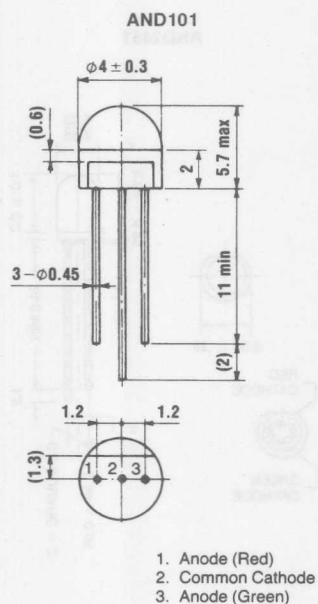
Absolute Maximum Ratings (T_A = 25°C)

Characteristics	Symbol	Rating			Unit
		Red	Green	Yellow	
Forward Current (DC)					
AND101, 116, 126, 171, 177, 187	I _F	25	25	25	mA
AND182, 205, 208, 222, 264	I _F	25	25	25	mA
AND2451	I _F	20	20		mA
Reverse Voltage					
AND101, 116, 126, 171, 177, 187	V _R	4	4	4	V
AND182, 205, 208, 222, 264	V _R	4	4	4	V
AND2451	V _R	5	5		V
Power Dissipation					
AND101, 116, 126, 171, 177, 187	P _D	75	75	75	mW
AND182, 205, 208, 222, 264	P _D	75	75	75	mW
AND2451	P _D	70	70		mW
Operating Temperature Range	T _{OPR}	−20 to +75			°C
Storage Temperature Range	T _{STC}	−30 to +100			°C

Electro-Optical Characteristics ($T_A = 25^\circ\text{C}$)

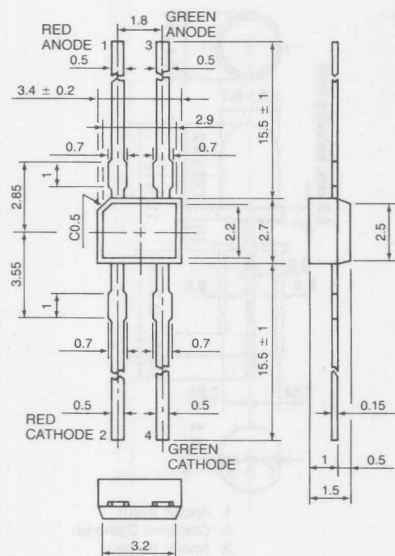
Characteristics	Symbol	Test Condition	Red			Green			Yellow			Units
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Forward Voltage												
AND116, 126, 171, 182	V _F	I _F = 20mA		2.1	2.8		2.1	2.8		2.1	2.8	V
AND205, 208, 222, 264	V _F	I _F = 20mA		2.1	2.8		2.1	2.8		2.1	2.8	V
AND177, 187	V _F	I _F = 20mA		1.8	2.4		2.1	2.8				V
AND2451	V _F	I _F = 20mA		2.1	3		2.1	3				V
AND101	V _F	I _F = 20mA		2.1	2.6		2.1	2.6				V
Reverse Current												
AND116, 126, 171, 182	I _R	V _R = 4V			100			5			100	μA
AND205, 208, 222, 264	I _R	V _R = 4V			100			5			100	μA
AND177, 187	I _R	V _R = 4V			100			5				μA
AND2451	I _R	V _R = 5V			100			5				μA
AND101	I _R	V _R = 5V			100			5				μA
Wavelength												
AND116, 126, 171, 182	λ _P	I _F = 15mA		635			565			585		nm
AND205, 208, 222, 264	λ _P	I _F = 15mA		635			565			585		nm
AND177, 187	λ _P	I _F = 20mA		660			567					nm
AND2451	λ _P	I _F = 20mA		700			567					nm
AND101	λ _P	I _F = 20mA		700			565					nm
Spectral Line Half Width												
AND116, 126, 171, 182	Δλ	I _F = 15mA		40			25			32		nm
AND205, 208, 222, 264	Δλ	I _F = 15mA		40			25			32		nm
AND177, 187	Δλ	I _F = 20mA		30			25					nm
AND101, 2451	Δλ	I _F = 20mA		100			25					nm

Outline Dimension (in millimeters)

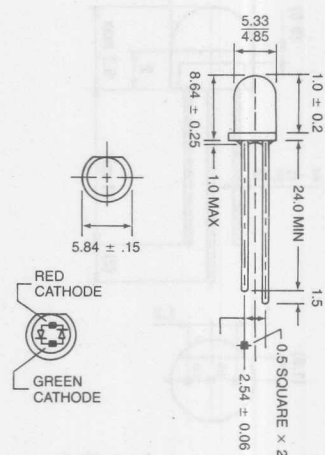


Outline Dimension (in millimeters)

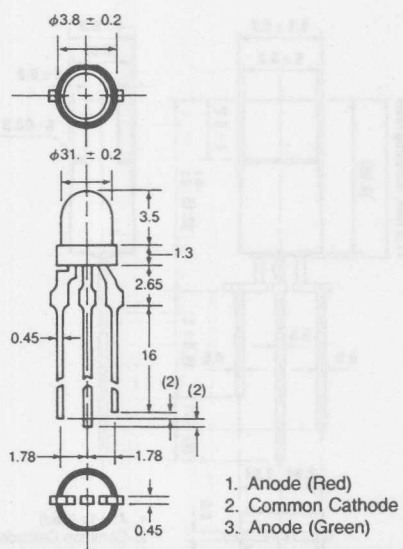
AND222



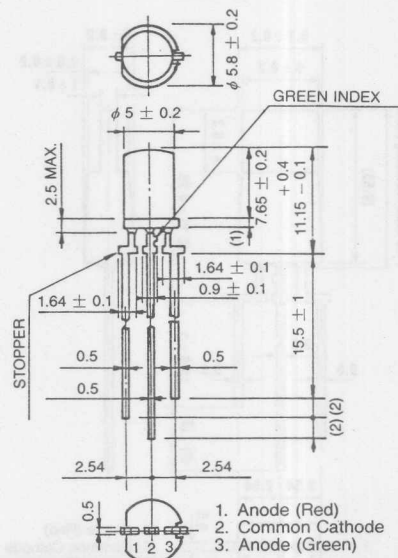
AND2451



AND126

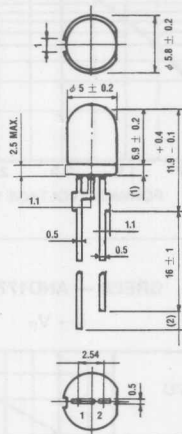


AND264SG

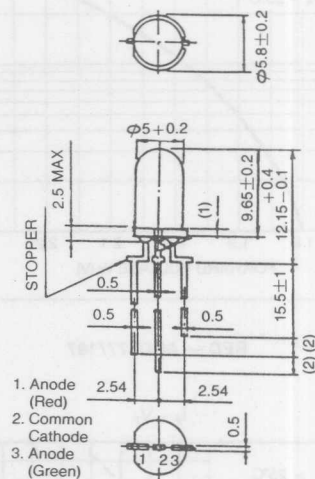


Outline Dimension (in millimeters)

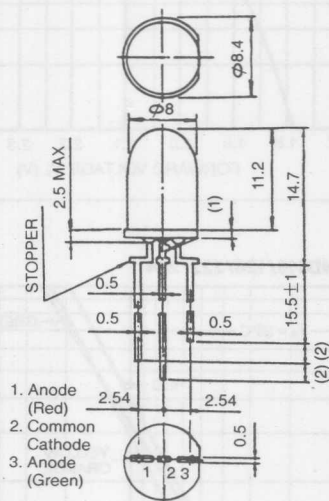
AND171SG



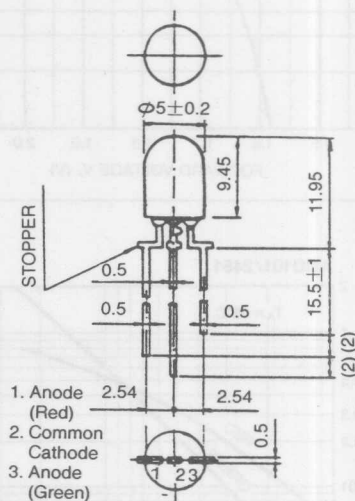
AND182SG



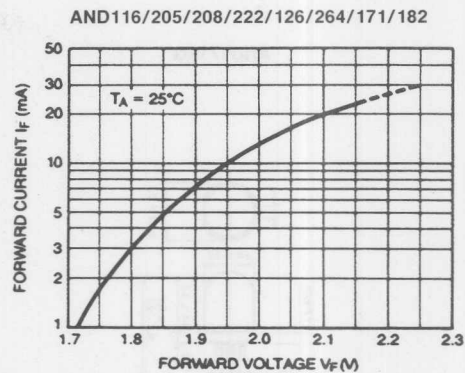
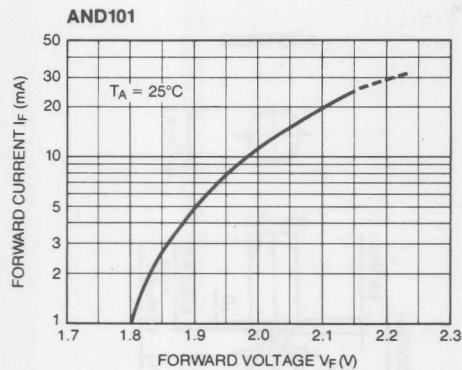
AND187RAG



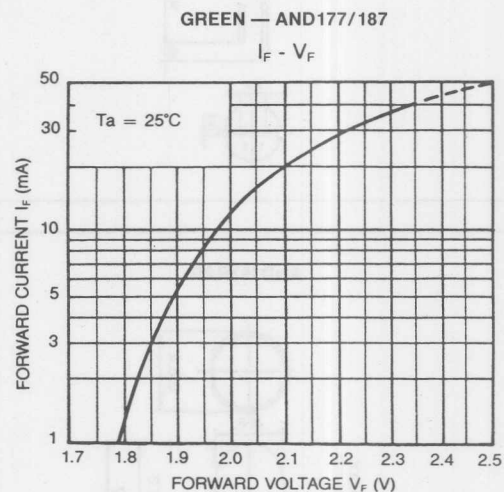
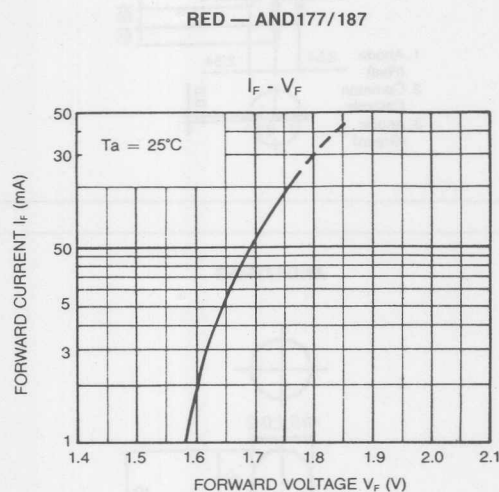
AND177RAG



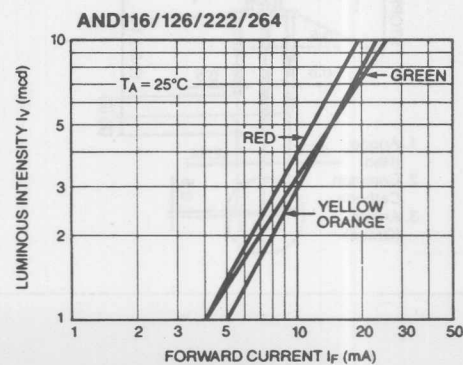
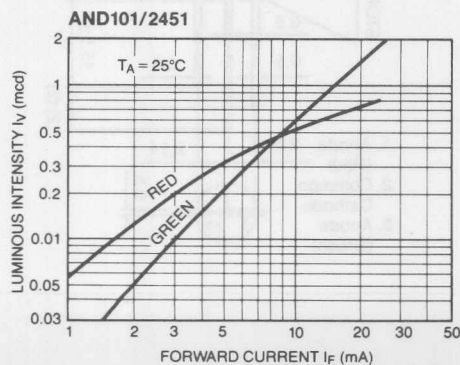
I_F vs. V_F



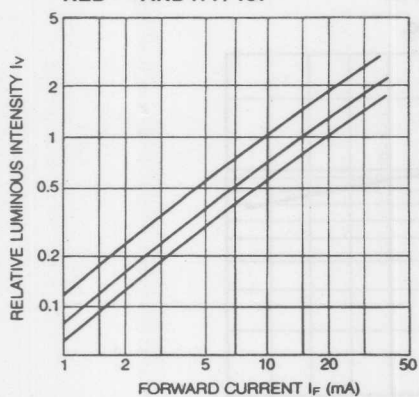
I_V vs. I_F



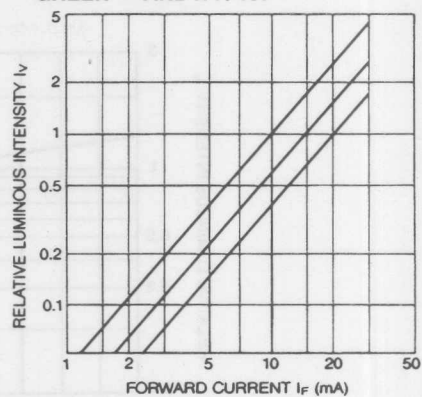
I_V vs. I_F



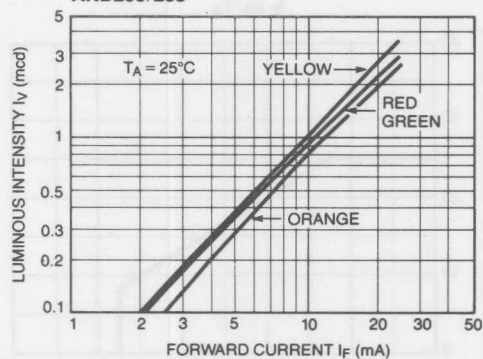
RED — AND177/187



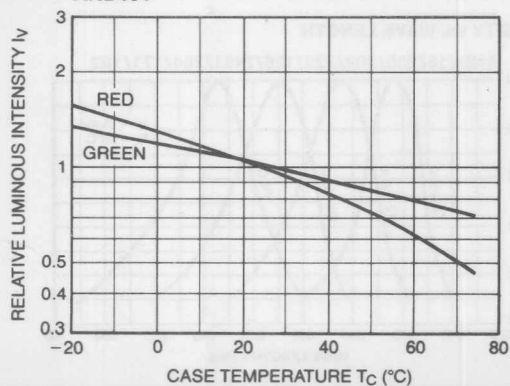
GREEN — AND177/187


 I_F vs. V_F

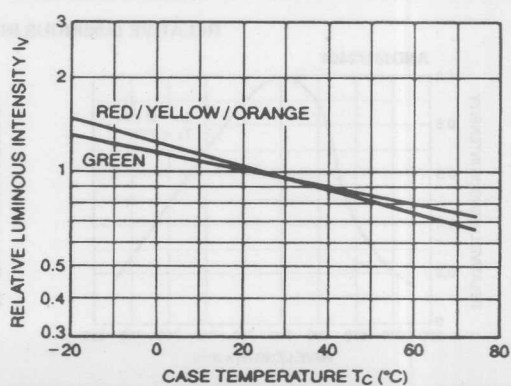
AND205/208



AND101

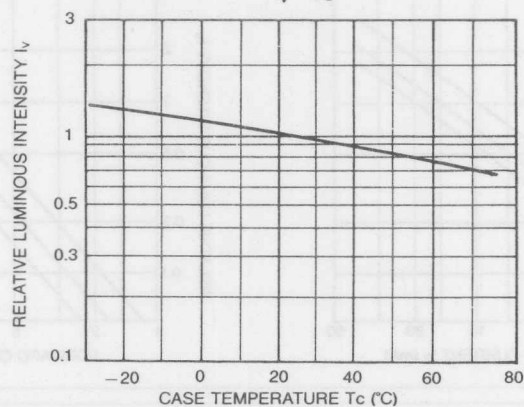


AND116/205/208/222/126/2451/264/171/182

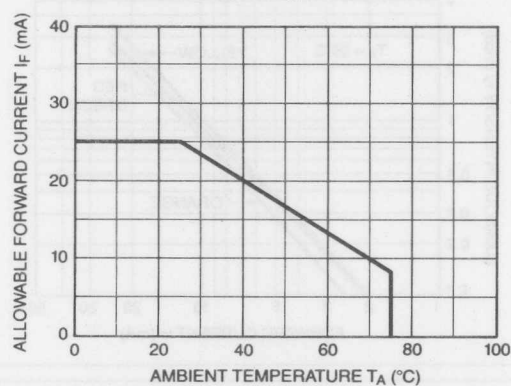


AND177/187

$I_V - T_C$

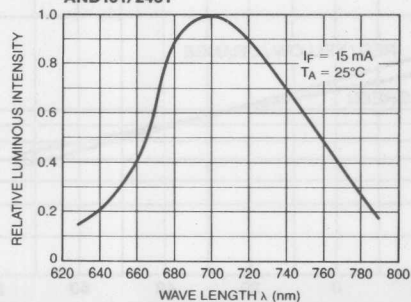


I_F vs. T_A

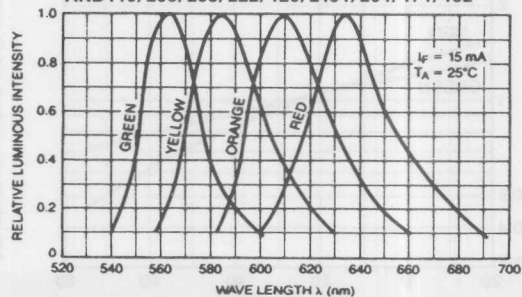


RELATIVE LUMINOUS INTENSITY vs. WAVE LENGTH

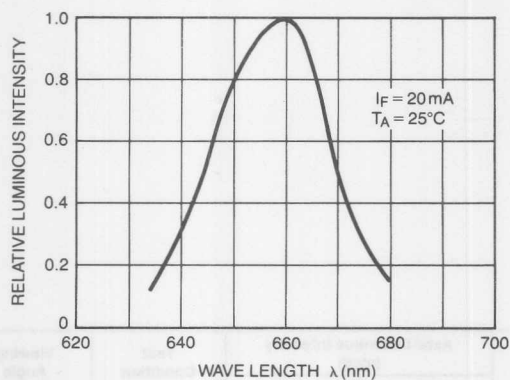
AND101/2451



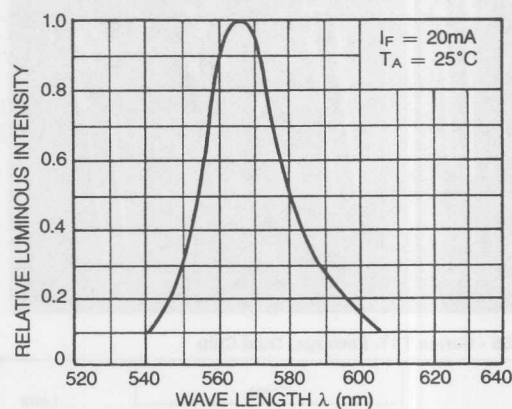
AND116/205/208/222/126/2451/264/171/182

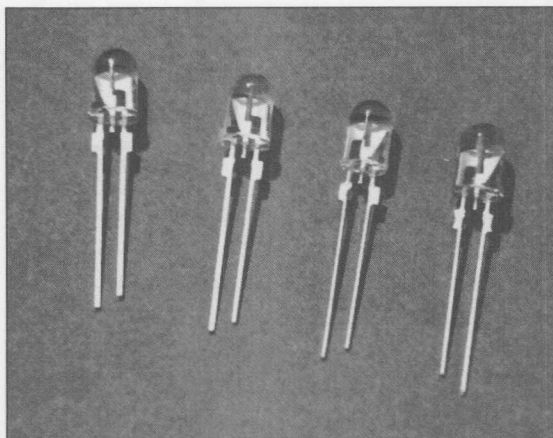


RED — AND177/187



GREEN — AND177/187





FEATURES

- Two chips per lamp
- Low drive current
- Standard T1 $\frac{3}{4}$ size
- Fast response time, suitable for pulse drive
- Wide radiation pattern, specially for backlighting

AND255 - Series T1 $\frac{3}{4}$ Package, Dual Chip

Part Number	Color		Lens Description	Axial Luminous Intensity (mcd)		Test Condition (I _F =mA)	Viewing Angle 2 θ $\frac{1}{2}$ (deg)
	Led	Lens		Min.	Typ.		
AND255AS	Red	LT Red	Clear	3	20	20	80
AND255AG	Green	LT Green	Clear	4	25	20	80
AND255AY	Yellow	LT Yellow	Clear	3	20	20	80
AND255AO	Orange	LT Orange	Clear	3	20	20	80
AND256CR	Red	Clear	Clear	85	350	20	90
AND256GC	Green	Clear	Clear	27.2	90	20	90

AND255AS, 255AG, 255AY, and 255AO
Electro-Optical Characteristics (T_A = 25°C)

Characteristics	Symbol	Test Condition	Red			Green			Yellow			Orange			Units
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Forward Voltage	V _F	I _F = 20mA	4.2	5.4		4.2	5.4		4.2	5.4		4.2	5.4		V
Reverse Current	I _R	V _R = 8V		100			100			100			100		μ A
Peak Emission Wavelength	λ_P	I _F = 20mA	635			565			585			610			nm
Spectral Line Half Width	$\Delta\lambda$	I _F = 20mA	40			25			32			35			nm

AND256CR
Electro-Optical Characteristics (T_A = 25°C)

Characteristics	Symbol	Test Condition	Red			Units
			Min.	Typ.	Max.	
Forward Voltage	V _F	I _F = 20mA		3.6	4.4	V
Reverse Current	I _R	V _R = 8V			100	μ A
Peak Emission Wavelength	λ_P	I _F = 20mA		660		nm
Spectral Line Half Width	$\Delta\lambda$	I _F = 20mA		25		nm

AND256GC
Electro-Optical Characteristics (T_A = 25°C)

Characteristics	Symbol	Test Condition	Red			Units
			Min.	Typ.	Max.	
Forward Voltage	V _F	I _F = 20mA		4.2	5.4	V
Reverse Current	I _R	V _R = 8V			5	μ A
Peak Emission Wavelength	λ_P	I _F = 20mA		567		nm
Spectral Line Half Width	$\Delta\lambda$	I _F = 20mA		25		nm

Absolute Maximum Ratings (T_A = 25°C)

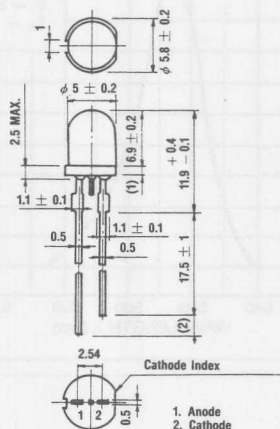
Characteristics	Symbol	Rating	Unit
Forward Current (DC)	I _F	30	mA
Reverse Voltage	V _R	4	V
Operating Temperature Range	T _{OPR}	-20 to +75	°C
Storage Temperature Range	T _{STG}	-30 to +100	°C

Absolute Maximum Ratings (T_A = 25°C)

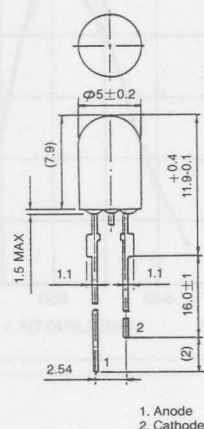
Characteristics	Symbol	Rating	Unit
Forward Current (DC)	I _F	30	mA
Reverse Voltage	V _R	8	V
Operating Temperature Range	T _{OPR}	-20 to +75	°C
Storage Temperature Range	T _{STG}	-30 to +100	°C

Outline Dimension (in millimeters)

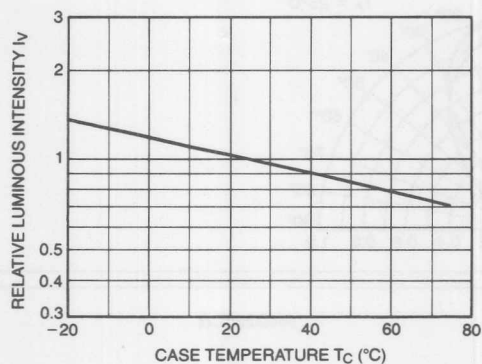
AND255A



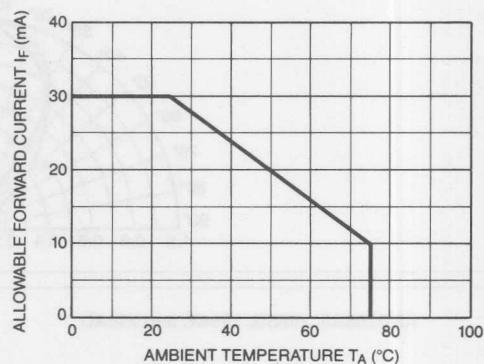
AND256



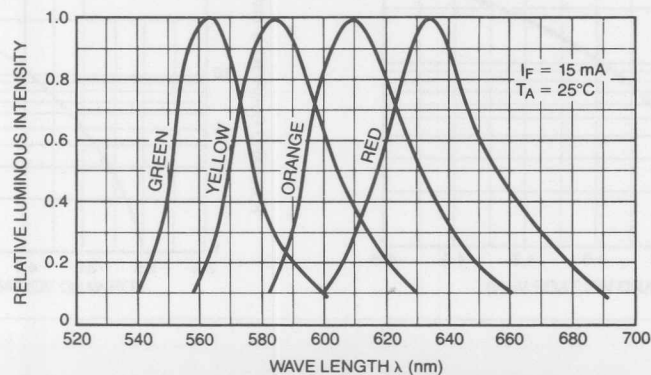
I_V vs. T_C

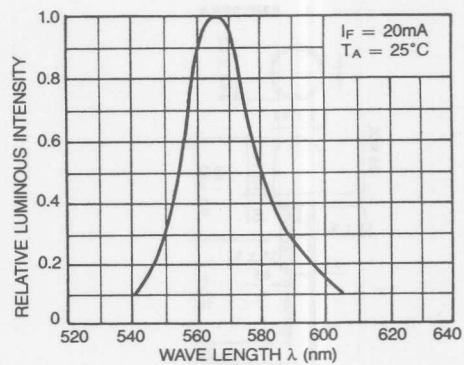
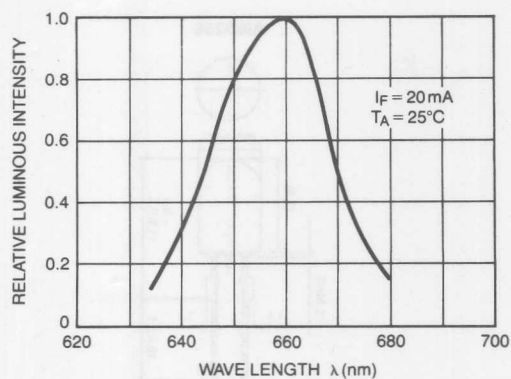


I_F vs. T_A



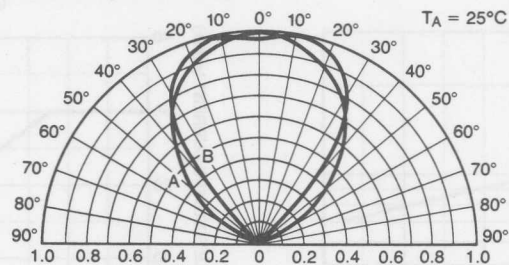
RELATIVE LUMINOUS INTENSITY vs. WAVE LENGTH



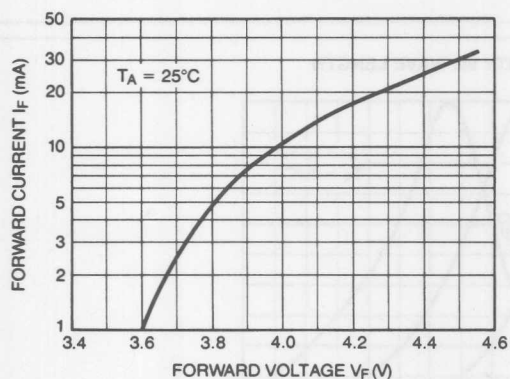


Radiation Pattern

A: Horizontally to Pin Terminal
B: Vertically to Pin Terminal

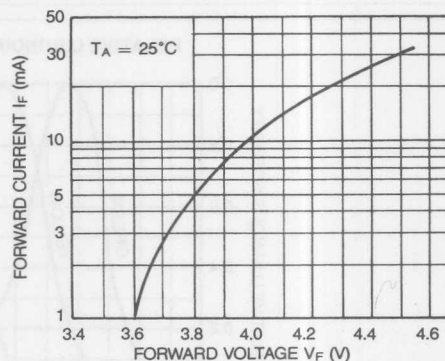


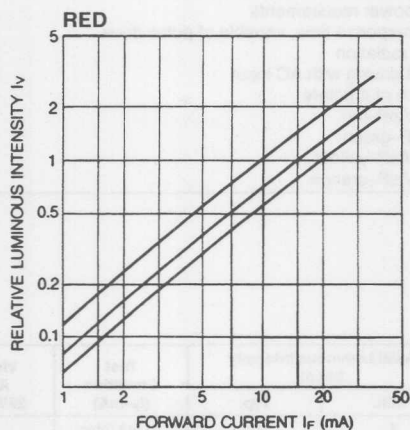
AND255AS, 255SG, 255AY, and 255AO



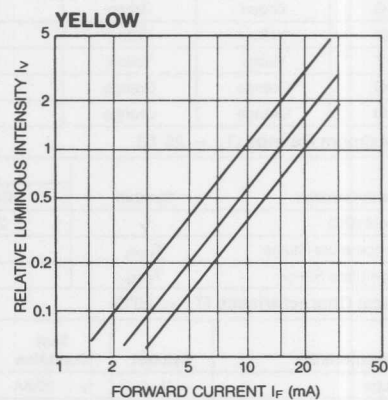
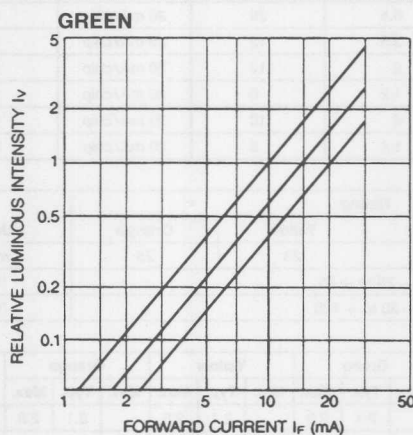
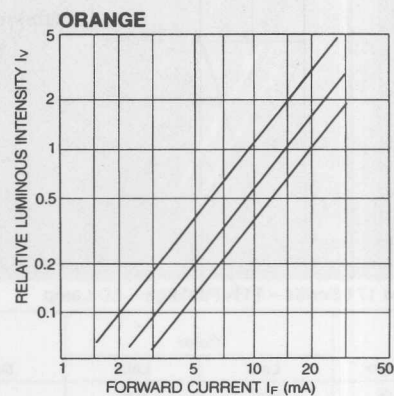
AND255CR

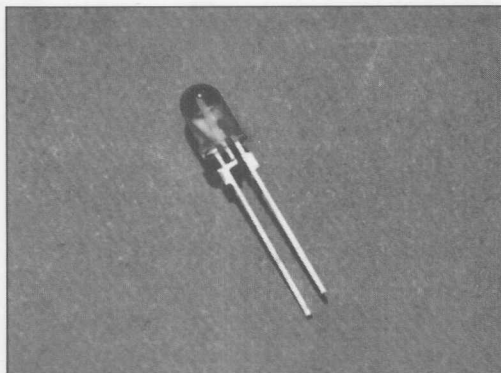
I_F vs. V_F





(This graph shows relative luminous intensity vs. forward current.
At three points ($I_F = 10, 15, 20$ mA) each relation is normalized.)





FEATURES

- 2 Chip anti-parallel connection
- Low power requirements
- Fast response time, capable of pulse drive
- Wide radiation
- Direct driving with AC input
- Choice of 4 colors
 - GaAsP-red
 - GaP-green
 - GaAsP-yellow
 - GaAsP-orange

AND170 and 171 Series - T1³/₄ Package - AC Lamp

Part Number	Color		Lens Description	Axial Luminous Intensity (mcd)		Test Condition (I _F -mA)	Viewing Angle 2θ _{1/2} (deg)
	Led	Lens		Min.	Typ.		
AND170S	Red	Red	Clear	2	10	20 mA/chip	90
AND171S	Red	Red	Diffused	1.2	6	20 mA/chip	90
AND170G	Green	Green	Clear	6.5	20	20 mA/chip	90
AND171G	Green	Green	Diffused	2.5	12	20 mA/chip	90
AND170Y	Yellow	Yellow	Clear	2	10	20 mA/chip	90
AND171Y	Yellow	Yellow	Diffused	1.2	6	20 mA/chip	90
AND170O	Orange	Orange	Clear	2	10	20 mA/chip	90
AND171O	Orange	Orange	Diffused	1.2	6	20 mA/chip	90

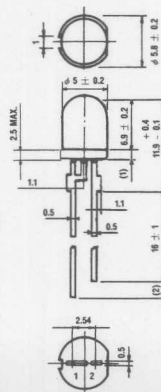
Absolute Maximum Ratings (T_A = 25°C)

Characteristics	Symbol	Rating				Unit
		Red	Green	Yellow	Orange	
Forward Current (DC)	I _F	25	25	25	25	mA
Operating Temperature Range	T _{OPR}	- 20 to + 75				°C
Storage Temperature Range	T _{STG}	- 30 to + 100				°C

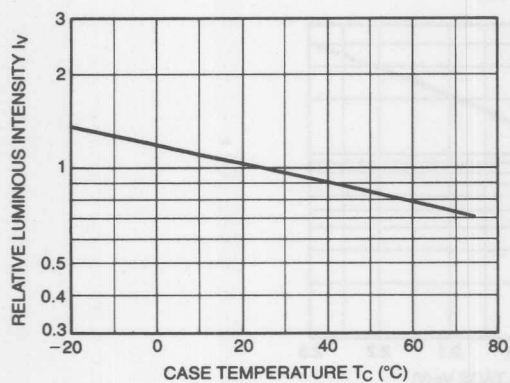
Electro-Optical Characteristics (T_A = 25°C)

Characteristics	Symbol	Test Condition	Red			Green			Yellow			Orange			Units
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Forward Voltage	V _F	I _F = 20mA		2.1	2.8		2.1	2.8		2.1	2.8		2.1	2.8	V
Peak Emission Wavelength	λ _P	I _F = 15mA		635			565			585			610		nm
Spectral Line Half Width	Δλ	I _F = 15mA		40			25			32			35		nm

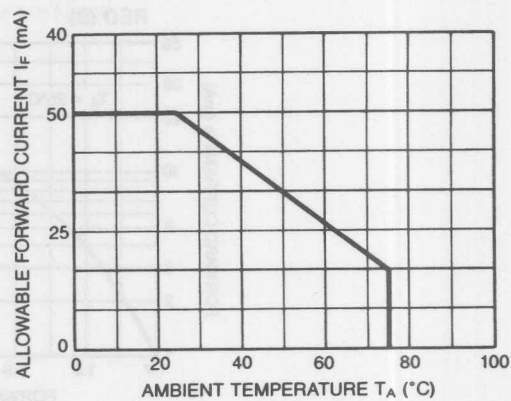
Outline Dimension (in mm)



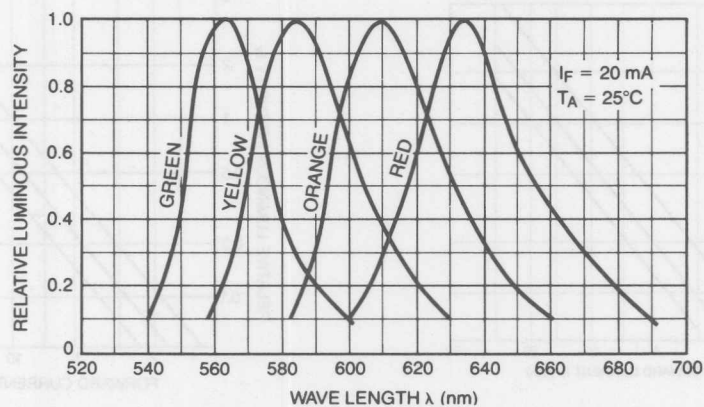
I_V vs. T_C



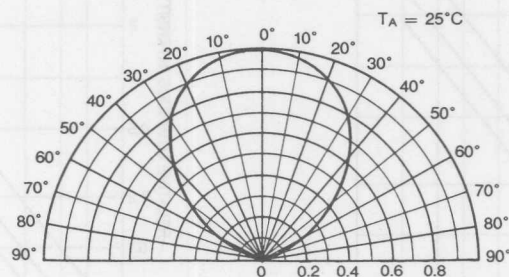
I_F vs. T_A



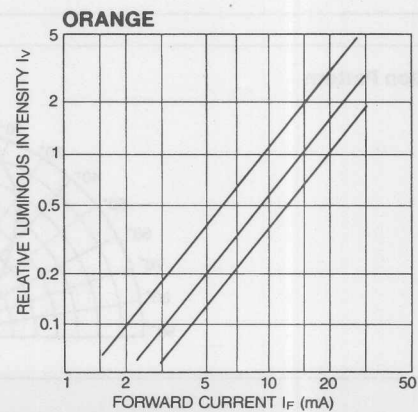
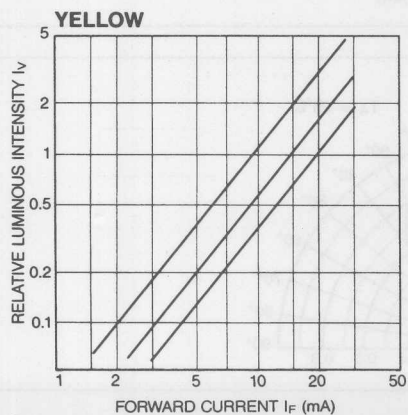
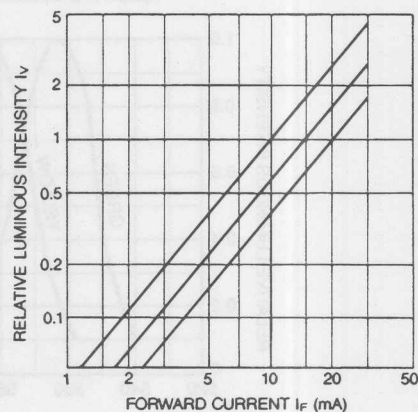
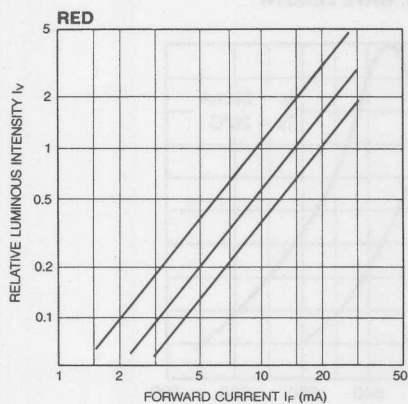
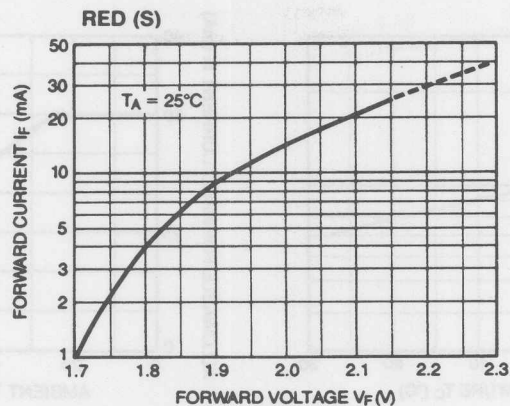
RELATIVE LUMINOUS INTENSITY vs. WAVE LENGTH

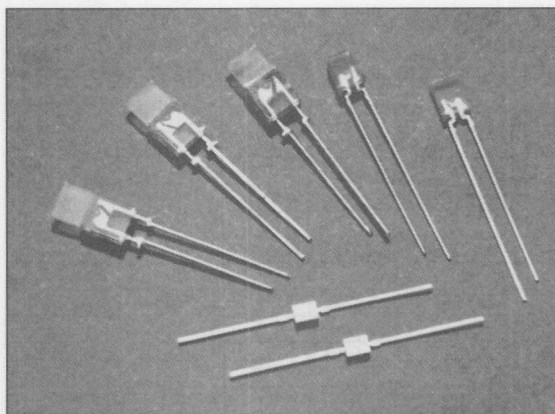


Radiation Pattern



I_F vs. V_F





Special Shapes - Rectangular - Various Sizes

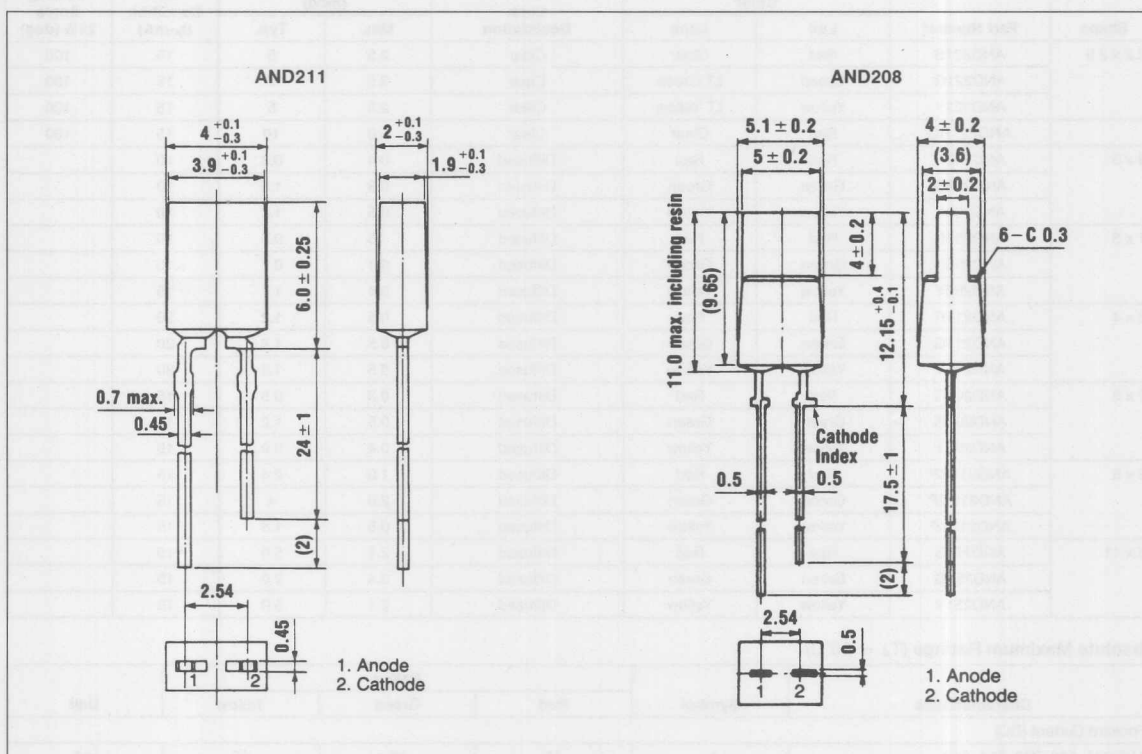
Shape	Part Number	Color		Lens Description	Axial Luminous Intensity (mcd)		Test Condition (I _F -mA)	Viewing Angle 2θ½ (deg)
		Led	Lens		Min.	Typ.		
2.2 x 2.9	AND221S	Red	Clear	Clear	2.5	5	15	100
	AND221G	Green	LT Green	Clear	3.5	7	15	100
	AND221Y	Yellow	LT Yellow	Clear	2.5	5	15	100
	AND221RC	Red	Clear	Clear	5.0	10	15	100
3 x 3	AND209R	Red	Red	Diffused	0.4	0.8	10	
	AND209G	Green	Green	Diffused	0.8	1.5	10	
	AND209Y	Yellow	Yellow	Diffused	0.5	1.3	10	
1 x 5	AND205R	Red	Red	Diffused	.15	0.5	10	
	AND205G	Green	Green	Diffused	0.4	0.7	15	
	AND205Y	Yellow	Yellow	Diffused	0.4	1.1	15	
2 x 4	AND211R	Red	Red	Diffused	0.5	1.2	20	
	AND211G	Green	Green	Diffused	0.5	1.2	20	
	AND211Y	Yellow	Yellow	Diffused	0.5	1.2	20	
2 x 5	AND208R	Red	Red	Diffused	0.3	0.5	15	
	AND208G	Green	Green	Diffused	0.5	1.2	15	
	AND208Y	Yellow	Yellow	Diffused	0.4	0.9	15	
2 x 5	AND218SP	Red	Red	Diffused	1.0	2.4	15	
	AND218GP	Green	Green	Diffused	2.0	4	15	
	AND218YP	Yellow	Yellow	Diffused	0.8	1.5	15	
5 x 11	AND251S	Red	Red	Diffused	2.1	5.0	15	
	AND251G	Green	Green	Diffused	3.4	9.0	15	
	AND251Y	Yellow	Yellow	Diffused	2.1	5.0	15	

Absolute Maximum Ratings (T_A = 25°C)

Characteristics	Symbol	Rating			Unit
		Red	Green	Yellow	
Forward Current (DC)					
AND205, 208, 209, 211, 218	I _F	20	25	25	mA
AND221, 251	I _F	25	25	25	mA
Reverse Voltage	V _R	4	4	4	V
Power Dissipation					
AND205, 208, 209, 211, 218	P _D	56	70	70	mW
AND221, 251	P _D	70	70	70	mW
Operating Temperature Range	T _{OPR}	-20 to +75			°C
Storage Temperature Range	T _{STG}	-30 to +100			°C

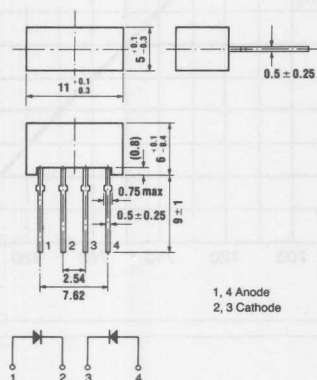
Electro-Optical Characteristics ($T_A = 25^\circ\text{C}$)

Characteristics	Symbol	Test Condition	Red			Green			Yellow			Units
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Forward Voltage												
AND205, 208, 209, 211, 218, 221	V _F	I _F = 20mA		2.1	2.8		2.1	2.8		2.1	2.8	V
AND251	V _F	I _F = 25mA		2.1	2.8		2.1	2.8		2.1	2.8	V
Reverse Current												
AND221	I _R	V _R = 4V			100			100			100	μA
AND205, 208, 209, 211, 218	I _R	V _R = 4V			5			5			100	μA
AND251	I _R	V _R = 4V			100			5			100	μA
Peak Emission Wavelength												
AND221, 251	λ _P	I _F = 15mA		635			565			585		nm
AND221RC	λ _P	I _F = 15mA		660								nm
AND205, 208, 209, 211, 218	λ _P	I _F = 15mA		700			565			585		nm
Spectral Line Half Width												
AND221	Δλ	I _F = 15mA		40			25			32		nm
AND205, 208, 209, 211, 218	Δλ	I _F = 10mA		100			25			32		nm
AND251	Δλ	I _F = 15mA		30			30			30		nm

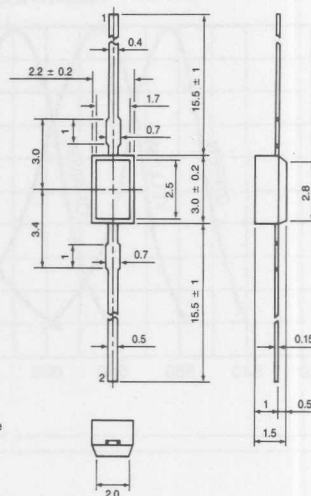




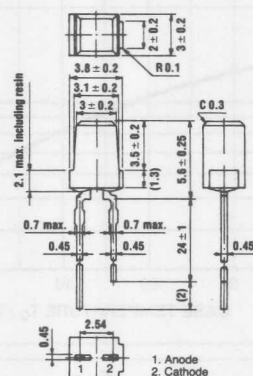
AND251



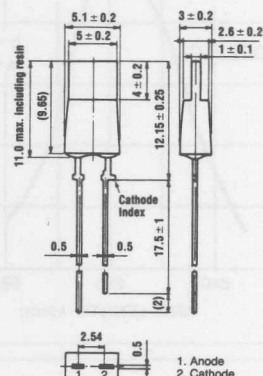
AND221



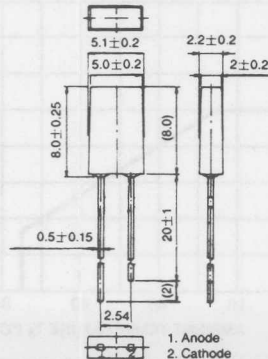
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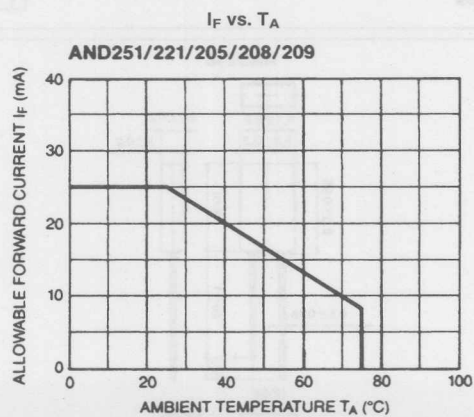
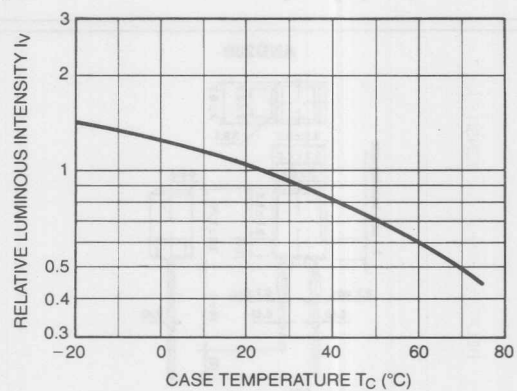
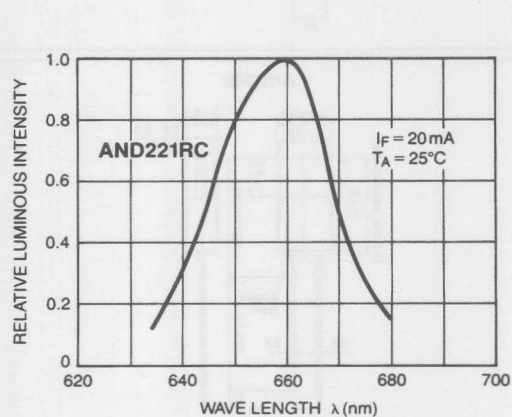
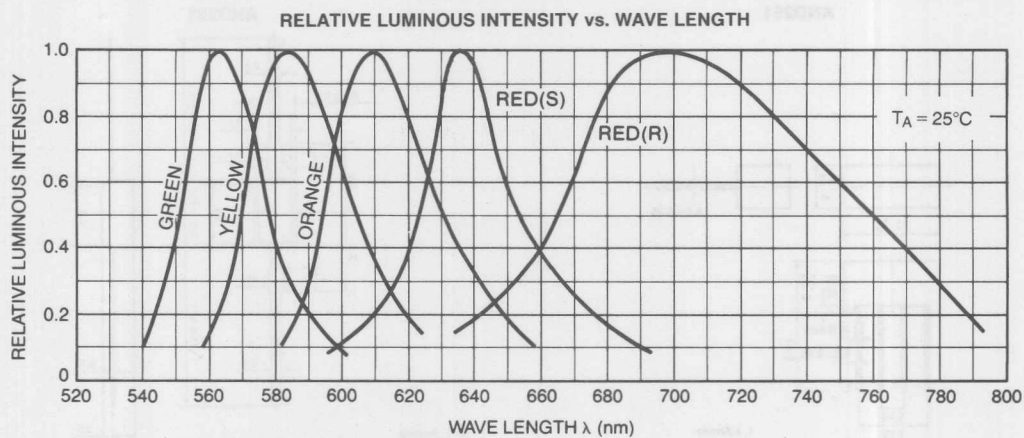


AND205

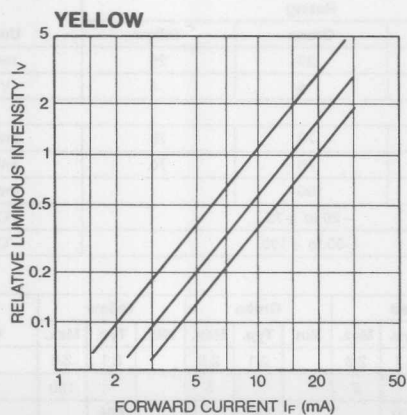
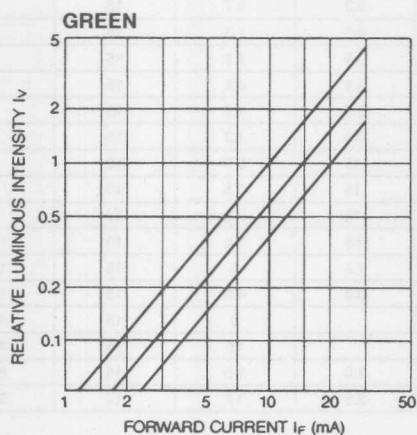
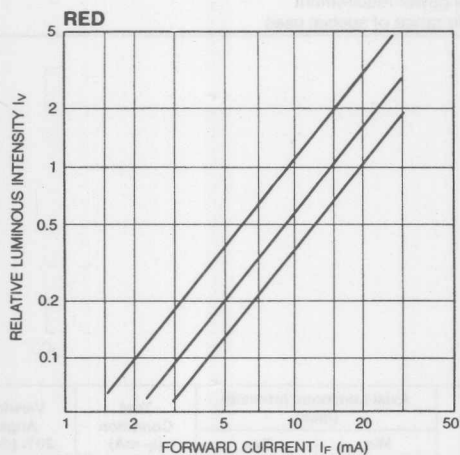


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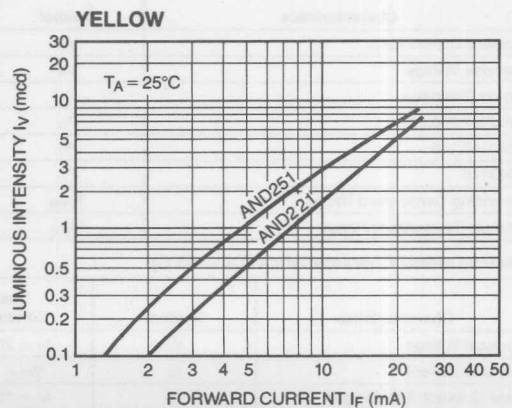
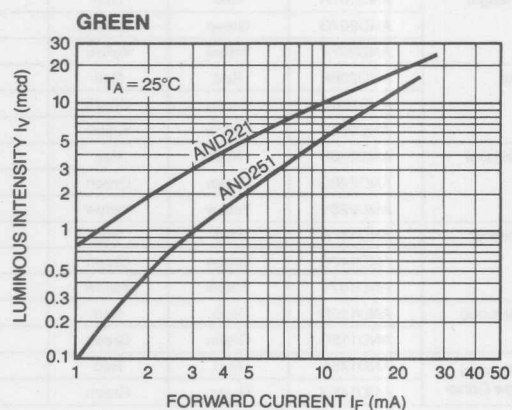
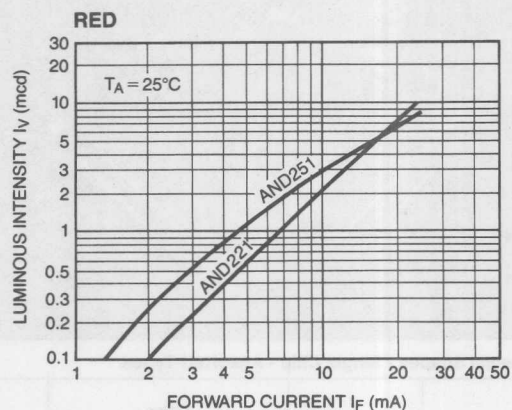




I_V vs. I_F



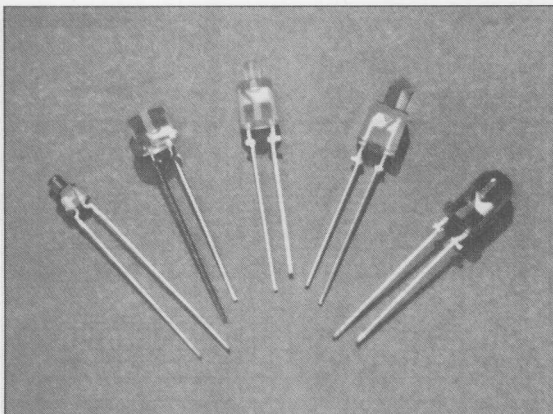
I_V vs. I_F





LED Lamps

SPECIAL SHAPES

AND115 Series
AND145 Series
AND147 SeriesAND206 Series
AND207 Series
AND226 Series

FEATURES

- Special shapes
- Low power requirement
- Wide range of special uses

Special Shapes - Single Chip - Assorted Types

Shape	Part Number	Color		Lens Description	Axial Luminous Intensity (mcd)		Test Condition (I _F =mA)	Viewing Angle 2θ ¹ (deg)
		Led	Lens		Min.	Typ.		
Triangle	AND207R	Red	Red	Diffused	0.3	0.7	15	
	AND207G	Green	Green	Diffused	0.5	1.3	15	
	AND207Y	Yellow	Yellow	Diffused	0.5	1.0	15	
Dot	AND206R	Red	Red	Diffused	0.4	0.8	15	
	AND206G	Green	Green	Diffused	0.5	1.6	15	
	AND206Y	Yellow	Yellow	Diffused	0.5	1.3	15	
Mini Dot	AND226R	Red	Red	Diffused	.15	0.5	10	
	AND226G	Green	Green	Diffused	.15	0.5	10	
	AND226Y	Yellow	Yellow	Diffused	.15	0.5	10	
Fresnel	AND147R	Red	Red	Clear	0.5	1.5	15	120
	AND147G	Green	Green	Clear	1.4	5	15	120
	AND147Y	Yellow	Yellow	Clear	0.8	4.5	15	120
Diamond	AND115R	Red	Red	Clear		3	15	45
	AND115G	Green	Green	Clear		16	15	45
Diamond Low Dome	AND145R	Red	Red	Clear	1.0	3.5	15	50
	AND145G	Green	Green	Clear	2.5	12	15	50

Absolute Maximum Ratings (TA = 25°C)

Characteristics	Symbol	Rating			Unit
		Red	Green	Yellow	
Forward Current (DC)	I _F	20	25	25	mA
Reverse Voltage	V _R	4	4	4	V
Power Dissipation					
AND207,206,226	P _D	56	70	70	mW
AND147,145	P _D	70	70	70	mW
AND115	P _D	90	100		mW
Operating Temperature Range	T _{OPR}	-20 to +75			°C
Storage Temperature Range	T _{STG}	-30 to +100			°C

Electro-Optical Characteristics (TA = 25°C)

Characteristics	Symbol	Test Condition	Red			Green			Yellow			Units
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Forward Voltage	V _F	I _F = 20mA		2.1	2.8		2.1	2.8		2.1	2.8	V
Reverse Current	I _R	V _R = 4V			5			5			100	μA
Peak Emission Wavelength	λ _P	I _F = 15mA		700			565			585		nm
Spectral Line Half Width	Δλ	I _F = 15mA		100			25			32		nm



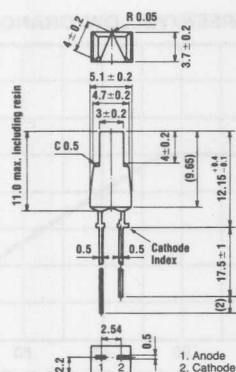
LED Lamps

SPECIAL SHAPES

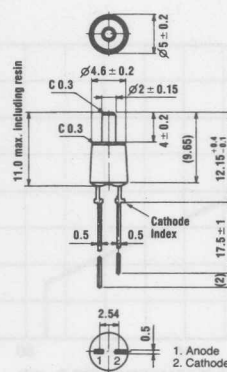
AND115 Series
AND145 Series
AND147 SeriesAND206 Series
AND207 Series
AND226 Series

1

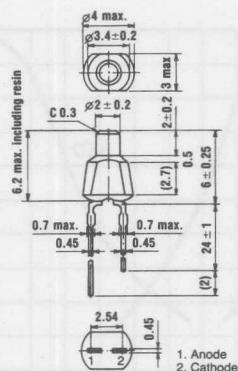
AND207



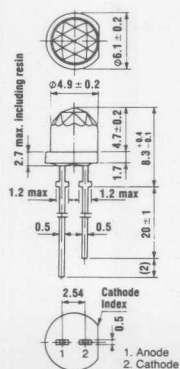
AND206



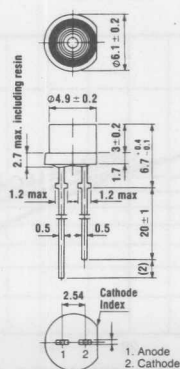
AND226



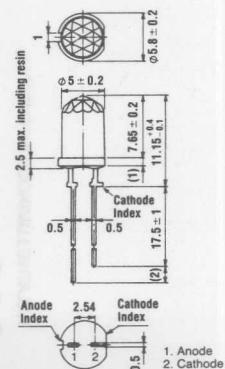
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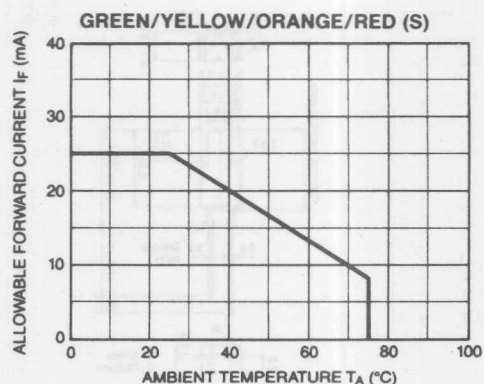
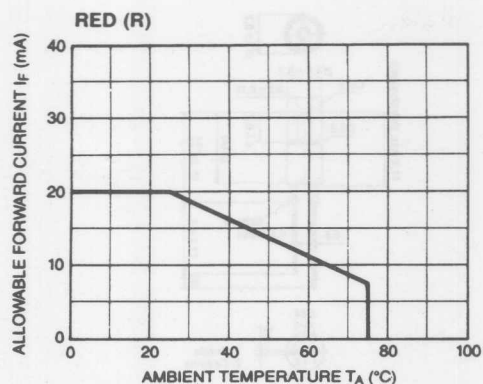


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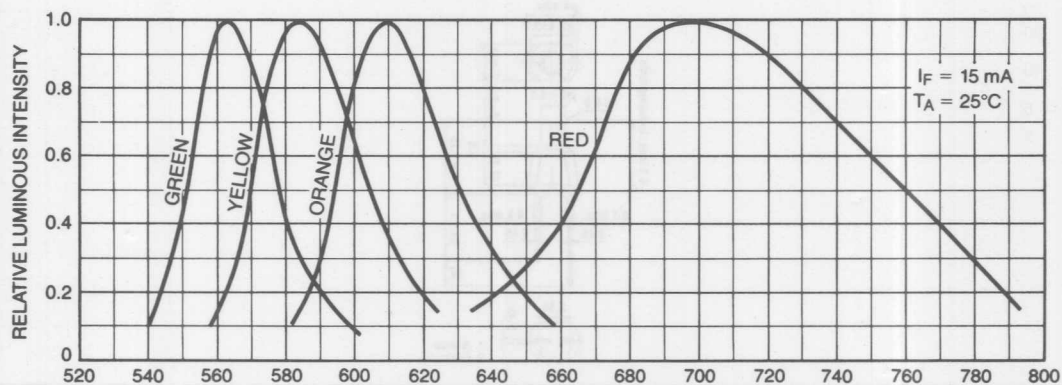
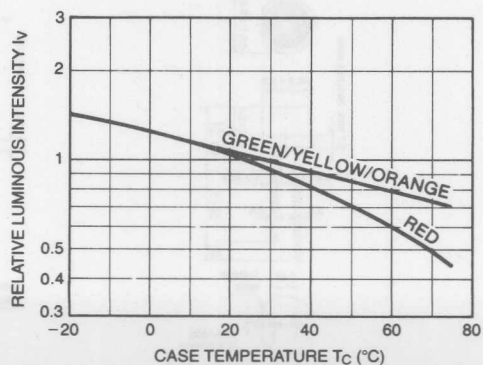


AND115

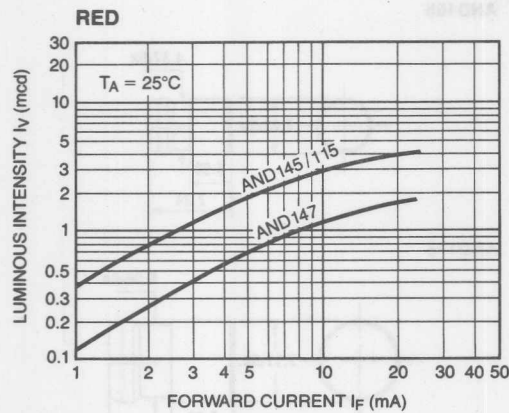


 I_F vs. T_A 

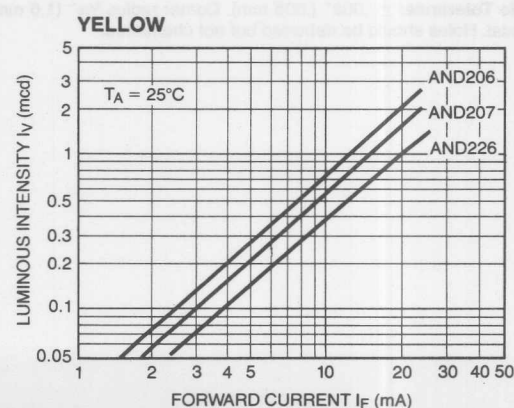
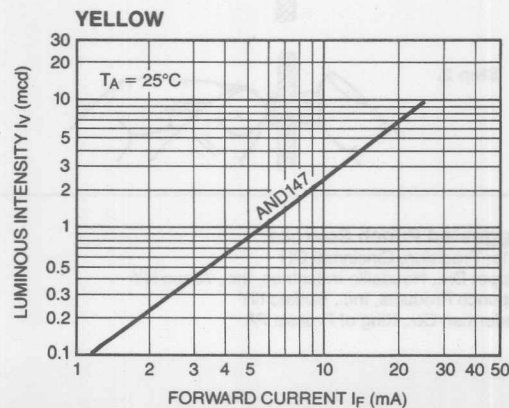
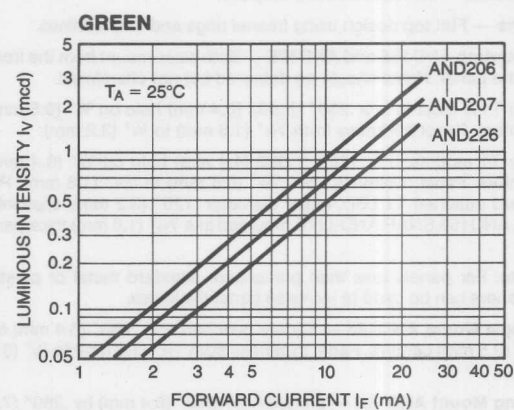
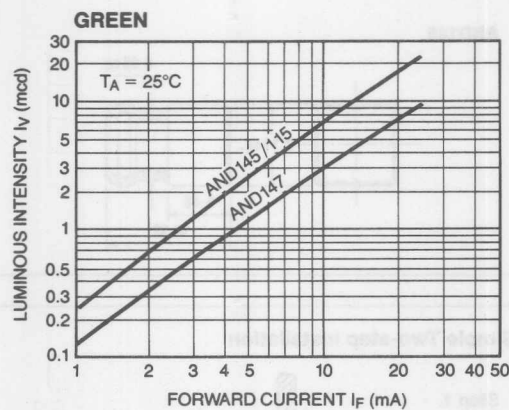
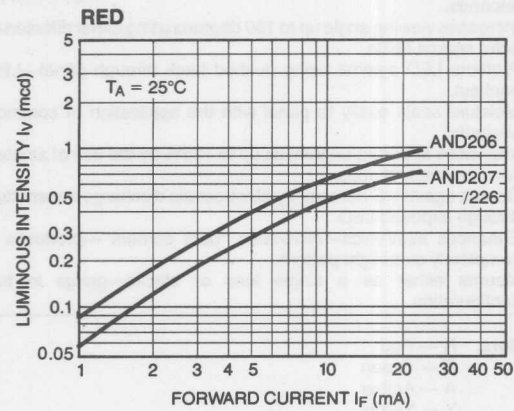
RELATIVE LUMINOUS INTENSITY vs. WAVE LENGTH

 I_F vs. T_C 

I_F vs. V_F



I_V vs. I_F





FEATURES

- Installs with finger pressure—no tools required—takes only six seconds.
- Increases viewing angle up to 180 degrees using either diffused or point source LEDs.
- Protects LED against being pushed back through panel—LED backout.
- Moisture seals easily to panel with the application of common sealants.
- Intensifies apparent brightness up to 125% by the use of striated lines and fresnel rings.
- Guards against IC damage by electrostatic discharge transmitted through exposed LED.
- Enhances aesthetics—eliminates “dark corners”—produces a completely even light pattern.
- Mounts either as a single lens or stacks—gangs in bar configuration.

Colors: R — Red
G — Green
A — Amber
Y — Yellow
C — Clear

Material — Cellulose acetate butyrate.

Lens — Flat top design using fresnel rings and striated lines.

Mounting AND165 and AND175 — Both sizes mount from the front of the panel. Holes should be deburred but not chamfered.

The T1^{3/4} mounts in a .250" \pm .002 (6.4 mm) hole on $\frac{3}{8}$ " (9.5 mm) centers. Panel thickness from $\frac{1}{16}$ " (1.6 mm) to $\frac{1}{8}$ " (3.2 mm).

The T1 mounts in a .172" \pm .002 (4.4 mm) hole on $\frac{1}{4}$ " (6.4 mm) centers. Panel thickness from $\frac{1}{32}$ " (0.8 mm) to $\frac{1}{16}$ " (1.6 mm). PC board attached T1 LED, major diameter .125" (3.2 mm), slips into the AND165 SNAP-AND-LITE mounted in a $\frac{1}{16}$ " (1.6 mm) thick panel.

Note: For panels less than prescribed, standard metal or plastic washers can be used to increase panel thickness.

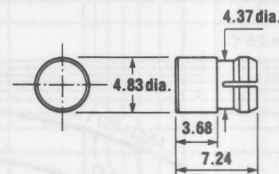
Single Mount AND185 — Square punched hole .250" (6.4 mm) on $\frac{3}{8}$ " (9.5 mm) centers. Panel thickness from $\frac{1}{16}$ " (1.6 mm) to $\frac{1}{8}$ " (3.2 mm).

Gang Mount AND185 — Slotted hole .250" (6.4 mm) by .280" (7.1 mm) x number of units minus .030" (0.8 mm). Panel thickness $\frac{1}{8}$ " (3.2 mm).

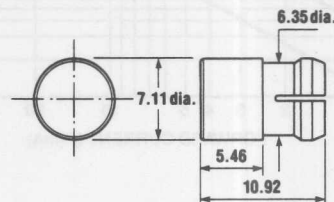
Hole Tolerance: \pm .002" (.005 mm). Corner radius $\frac{1}{16}$ " (1.6 mm) typical. Holes should be deburred but not chamfered.

Outline Dimension (in millimeters)

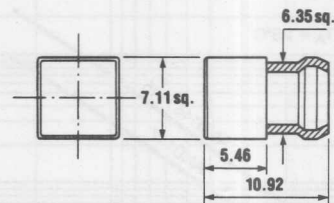
AND165



AND175



AND185

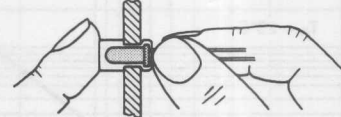


Simple Two-step installation

Step 1.



Step 2.



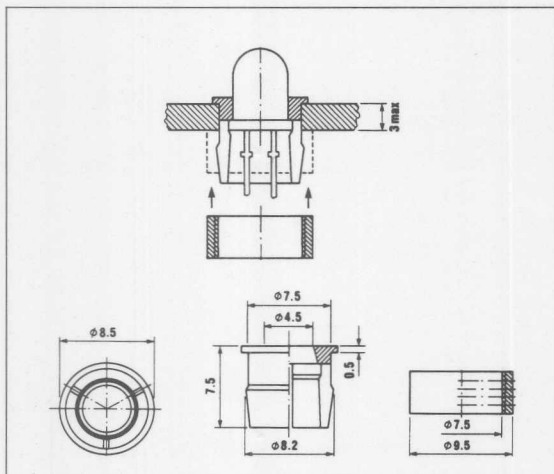
Suggested Punch Sources:

Porter Precision, Cincinnati OH
Strippert Div., Houdaille Industries, Inc., Akron NY
Unipunch Products, Inc., Buffalo NY
Wiederman Co., King of Prussia PA

AND5BMH

FEATURES

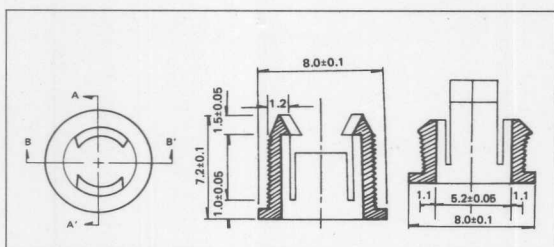
- For tapered lens T1 $\frac{3}{4}$ LED's
- Two piece mounting ring
- 0.12" (3 mm) max. panel thickness
- Body material — ABS
- Ring material — Polyethylene
- Color — Black



AND1H

FEATURES

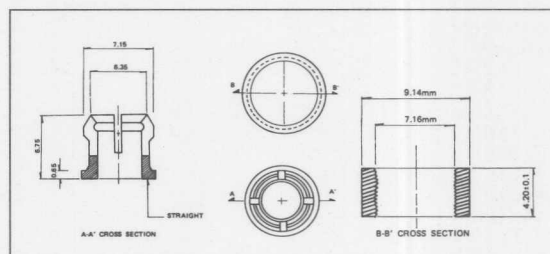
- For T1 $\frac{3}{4}$ LED's (low cost 8AMH)
- One piece construction
- Installation from front of panel
- Body material — Polypropylene
- Color — Black



AND2H

FEATURES

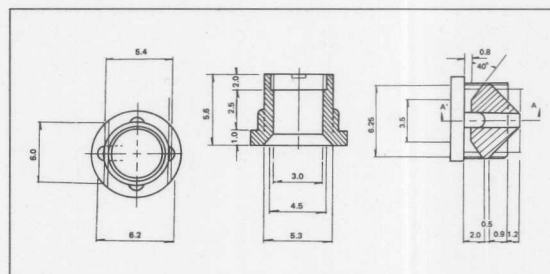
- For T1 $\frac{3}{4}$
- Two piece mounting ring
- Body material — Polypropylene
- Color — Black



AND4H

FEATURES







- Special for T1 LED's.
- One piece construction.
- Installation from front of panel thickness.
- Body material — Nylon.
- Color — Black.





Quick Reference Guide	2-2
7 Segment, .3 inch Displays Product Data	2-4
7 Segment, .43 inch Displays Product Data	2-10
7 Segment, .56 inch Displays Product Data	2-13
7 Segment, Super Bright Displays Product Data	2-17
7 Segment, Ultra Bright Displays Product Data	2-22
7 Segment, Large Size Displays Product Data	2-27
16 Segment, Single Digit Displays Product Data	2-33
Dot Matrix, 1 Digit Displays Product Data	2-41
Bar Graphs, Arrays Product Data	2-43




7 SEGMENTS				
Display Font	STANDARD BRIGHT	Common Cathode	Common Anode	Page
	.3 inch			
	1 Dig 10 Pin Red 1 Dig 10 Pin Green 1 Dig 14 Pin Red 1 Dig 14 Pin Green	AND332R AND332G — —	— — AND333R/AND335R AND333G/AND335G	2-4
	1/2 Dig Red 1/2 Dig Green	AND334R AND334G		2-4
	2 Dig Red 2 Dig Green	AND322R AND322G	AND323R AND323G	2-4
	.43 inch			
	1 Dig Red 1 Dig Green	AND342R AND342G	AND343R/AND345R AND343G/AND345G	2-10
	1/2 Dig Red 1/2 Dig Green	AND344R AND344G		2-10
	.56 inch			
	1 Dig Red 1 Dig Green	AND362R AND362G	AND363R AND363G	2-13
	1/2 Dig Red 1/2 Dig Green	AND364R AND364G	AND365R AND365G	2-13
	2 Dig Red 2 Dig Green	AND366R AND366G	AND367R AND367G	2-13
	SUPER BRIGHT (Red)			
	.3 inches 1 Dig	AND332S	AND333S/AND335S	2-17
	1/2 Dig		AND334S	
	.43 inches 1 Dig	AND342S	AND343S/AND345S	
1/2 Dig		AND344S		
.56 inches 1 Dig	AND362S	AND363S		
1/2 Dig	AND364S	AND365S		
	ULTRA BRIGHT (Red)			
	.3 inches 1 Dig	AND332UR/AND335UR	AND333UR	2-22
	1/2 Dig		AND334UR	
	.43 inches 1 Dig	AND342UR/AND345UR	AND343UR	
1/2 Dig		AND344UR		
.56 inches 1 Dig	AND362UR	AND363UR		
1/2 Dig	AND364UR	AND365UR		
	LARGE SIZE			
	.8 inches Red .8 inches Green 2.3 inches Red 2.3 inches Green 4.0 inches Red 4.0 inches Green	AND8010SCL AND8010GCL AND2307SCL AND2307GCL AND4107SCL AND4107GCL	AND8010SAL AND8010GAL AND2307SAL AND2307GAL AND4107SAL AND4107GAL	2-27



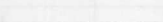
ALPHANUMERIC - 16 SEGMENT

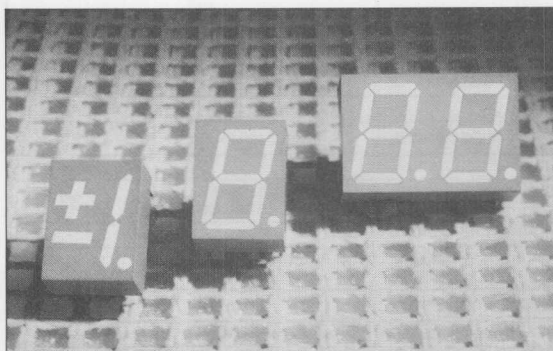
	.5 inches 1 Dig			
	Red Green	AND370R AND370G	AND371R AND371G	2-33
	.54 inches 2 Dig			
	Red	AND54200CLB	AND54200ALB	2-33
	.8 inches 1 Dig			
	Red Green	AND8010SCLB AND8010GCLB	AND8010SALB AND8010GALB	2-33
2.3 inches 1 Dig				
Red Green				
		AND2316SCLB AND2316GCLB	AND2316SALB AND2316GALB	2-33

DOT MATRIX - 5 x 7 Format

		Common Column	Common Row	Page
	2.0 inches			
	a. Red b. Green	AND2570S AND2570G	AND2571S AND2571G	2-41

ARRAYS

		Red	Green	Mixed	Page
	Dual Color Bar Graph	AND10KHGL			2-43
	Bar Graphs			—	
	10 Columns 1 Row 5 Position 1 Row	AND10KRL/KSL AND208-5R	AND10KGL AND208-5G	AND10KYL	



FEATURES

- 0.3" character height
- Available in RED or GREEN
- Application: Numerical Readout for Instrument and Industrial products
- Industry pin for pin compatibility
- Both common cathode or common anode are available
- Single or dual digit displays

Number of Digits	Common		Color		Number of Pins
	Cathode	Anode	Display	Face	
1	AND332R	—	Red	Red	10
1	AND332G	—	Green	Green	10
1	—	AND333R/AND335R*	Red	Red	14
1	—	AND333G/AND335G*	Green	Green	14
1/2	AND334R		Red	Red	14
1/2	AND334G		Green	Green	14
2	AND322R	AND323R	Red	Red	14
2	AND322G	AND323G	Green	Green	14

Absolute Maximum Ratings (T = 25°C)

Characteristic	Symbol	AND33X	AND32X	Unit
DC Forward Current/Segment	$I_F(\text{DC})/\text{SEG}$	20	13	mA
Pulse Forward Current/Segment	I_{FP}/SEG	110	50	mA
Reverse Voltage/Segment	V_R	6	3	V
Operating Temperature Range	T_{opr}	—40 to 85	—30 to 75	°C
Storage Temperature Range	T_{stg}	—40 to 85	—30 to 80	°C

Electro-Optical Characteristics

Characteristics	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage						
AND33X	V_F	$I_F = 10\text{mA}$	1.7	2	2.5	V
AND32X	V_F	$I_F = 13\text{mA}$	1.8	2.1	2.5	V
Reverse Current	I_R	$V_R = 6\text{V}$			5	μA
Luminous Intensity Per Segment						
AND33X	Red	$I_V = 5\text{mA}$	0.3	0.6		mcd
	Green	$I_V = 10\text{mA}$	0.13	0.4		mcd
AND32X	Red	$I_V = 5\text{mA}$	0.13	0.26		mcd
	Green	$I_V = 10\text{mA}$		0.34		mcd

* AND333 Series, right hand decimal point
AND335 Series, left hand decimal point

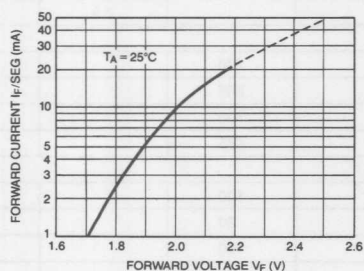
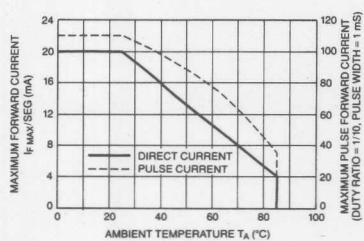
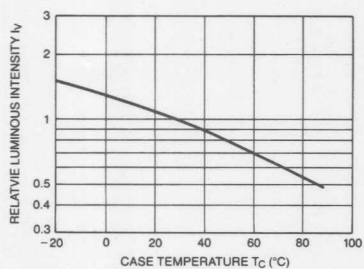
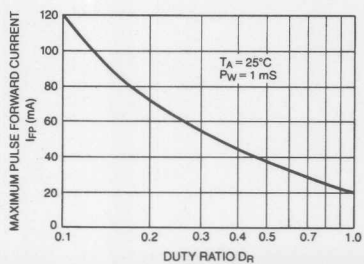
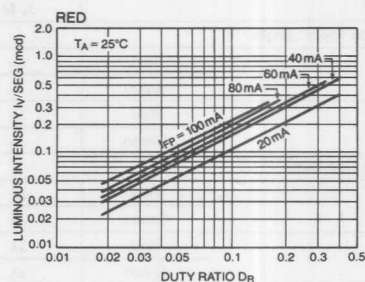


Electro-Optical Characteristics (Continued)

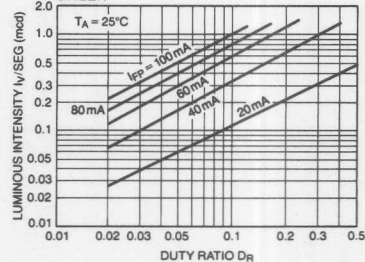
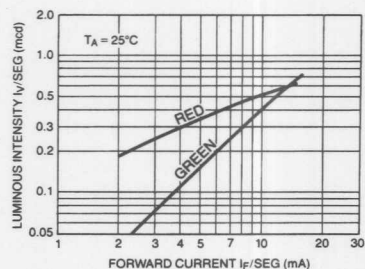
Characteristics	Symbol	Condition	Min.	Typ.	Max.	Unit
Luminous Intensity Matching Ratio						
AND33X	I_V-M	$I_F = 10mA$			2.3	
AND32X	I_V-M	$I_F = 5mA$			2.5	
Peak Emission Wave Length						
AND33X	Red	λ_P	$I_F = 10mA$	700		nm
	Green	λ_P	$I_F = 10mA$	565		nm
AND32X	Red	λ_P	$I_F = 5mA$	700		nm
	Green	λ_P	$I_F = 5mA$	565		nm
Spectral Line Half Width						
AND33X	Red	$\Delta\lambda$	$I_F = 10mA$	100		nm
	Green	$\Delta\lambda$	$I_F = 10mA$	30		nm
AND32X	Red	$\Delta\lambda$	$I_F = 5mA$	100		nm
	Green	$\Delta\lambda$	$I_F = 5mA$	30		nm



AND330 Series

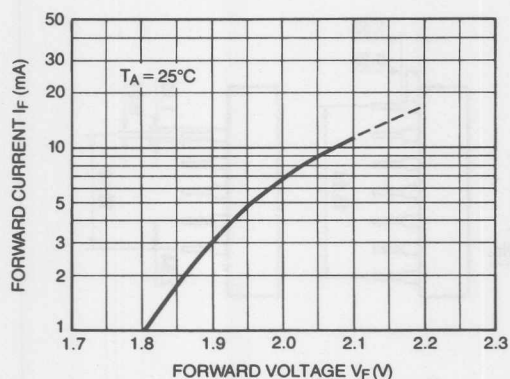
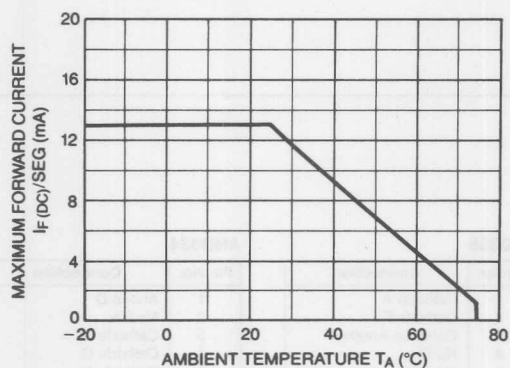
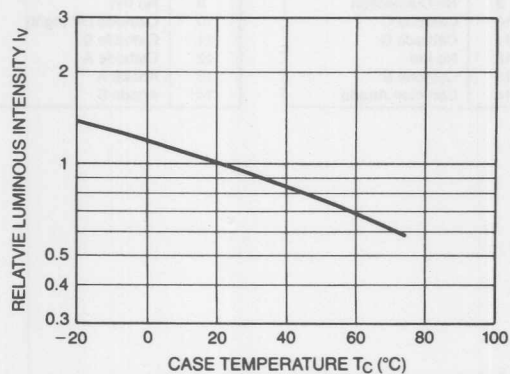
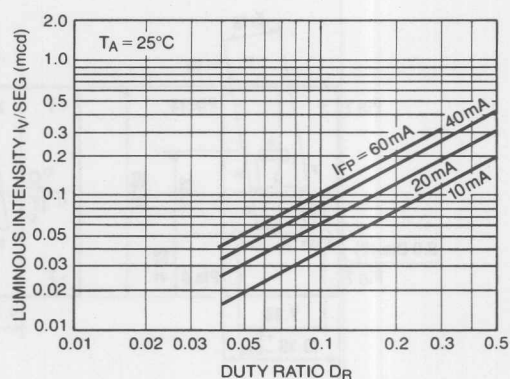
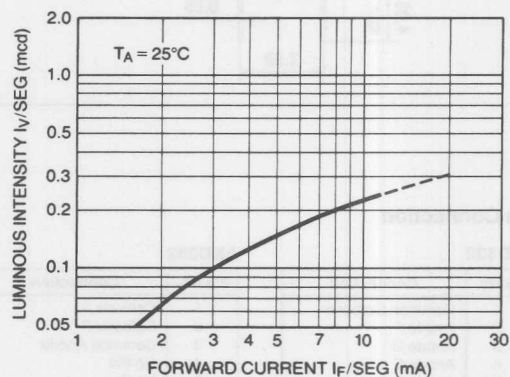
 I_F/SEG vs. V_F  I_{FMAX}/SEG vs. T_A  I_V vs. T_C  I_{FP} vs. D_R  I_V/SEG vs. D_R 

GREEN

 I_V/SEG vs. I_F/SEG 



AND320 Series

 I_F vs. V_F  $I_{F\text{MAX}}/\text{SEG}$ vs. T_A  I_V vs. T_C  I_V/SEG vs. D_R  I_V/SEG vs. I_F 

Outline Dimension (in millimeters)



AND332

Pin No.	Connection
1	Common Cathode
2	Anode F
3	Anode G
4	Anode E
5	Anode D
6	Common Cathode
7	Anode DP (right)
8	Anode C
9	Anode B
10	Anode A

AND333

Pin No.	Connection
1	Cathode A
2	Cathode F
3	Common Anode
4	No Pin
5	No Pin
6	No Connection
7	Cathode E
8	Cathode D
9	Cathode DP (right)
10	Cathode C
11	Cathode G
12	No Pin
13	Cathode B
14	Common Anode

AND335

Pin No.	Connection
1	Cathode A
2	Cathode F
3	Common Anode
4	No Pin
5	No Pin
6	Cathode DP (left)
7	Cathode E
8	Cathode D
9	No Connection
10	Cathode C
11	Cathode G
12	No Pin
13	Cathode B
14	Common Anode

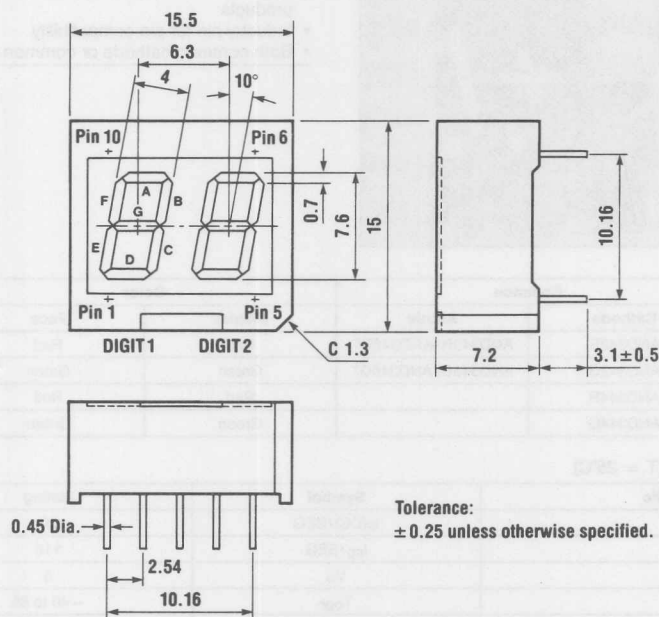
AND334

Pin No.	Connection
1	Anode D
2	No Pin
3	Cathode D
4	Cathode C
5	Cathode E
6	Anode E
7	Anode C
8	Anode DP (right)
9	No Pin
10	Cathode DP (right)
11	Cathode B
12	Cathode A
13	Anode A
14	Anode B



AND320 Series

Outline Dimension (in millimeters)



2

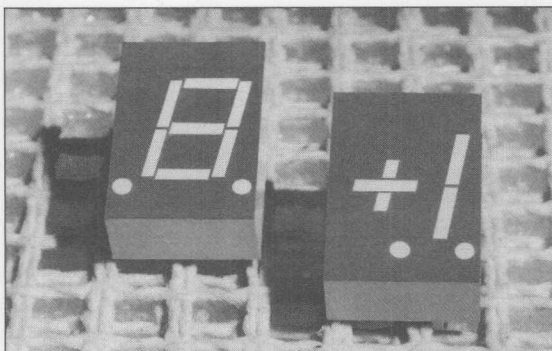
Pin Connection

AND322

Pin No.	Connection
1	Anode G
2	No Pin
3	Anode A
4	Anode F
5	Digit 2 Common Cathode
6	Anode D
7	Anode E
8	Anode C
9	Anode B
10	Digit 1 Common Cathode

AND323

Pin No.	Connection
1	Cathode G
2	No Pin
3	Cathode A
4	Cathode F
5	Digit 2 Common Anode
6	Cathode D
7	Cathode E
8	Cathode C
9	Cathode B
10	Digit 1 Common Anode



FEATURES

- 0.43" character height
- Available in RED or GREEN
- Application: Numerical Readout for Instrument and Industrial products
- Industry pin for pin compatibility
- Both common cathode or common anode are available

Number of Digits	Common		Color		Number of Pins
	Cathode	Anode	Display	Face	
1	AND342R	AND343R/AND345R*	Red	Red	14
1	AND342G	AND343G/AND345G*	Green	Green	14
1/2	AND344R		Red	Red	14
1/2	AND344G		Green	Green	14

Absolute Maximum Ratings (T = 25°C)

Characteristic	Symbol	Rating	Unit
DC Forward Current/Segment	$I_F(\text{DC})/\text{SEG}$	20	mA
Pulse Forward Current/Segment	I_{FP}/SEG	110	mA
Reverse Voltage/Segment	V_R	6	V
Operating Temperature Range	T_{opr}	-40 to 85	°C
Storage Temperature Range	T_{stg}	-40 to 85	°C

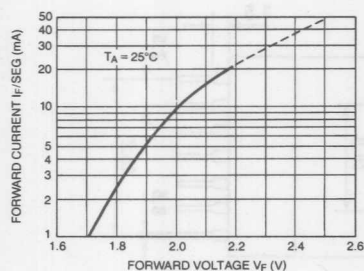
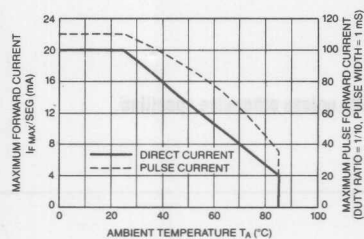
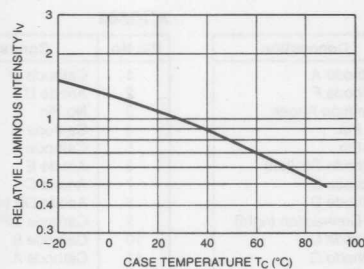
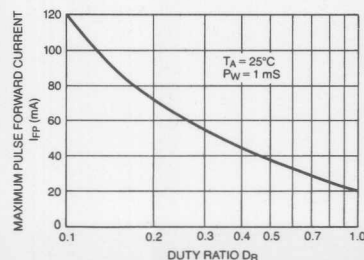
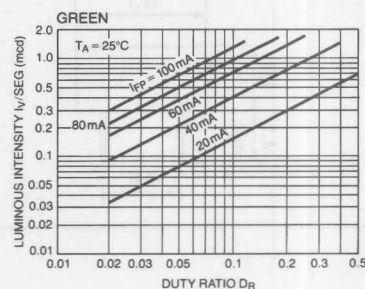
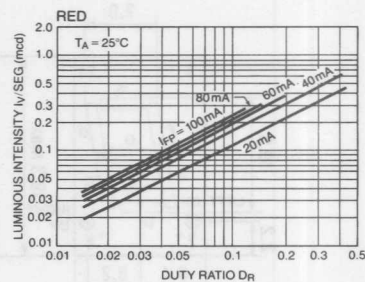
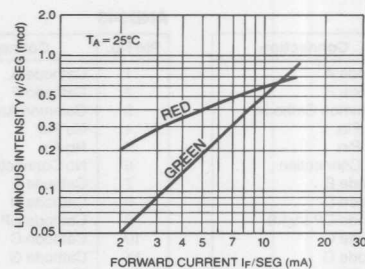
Electro-Optical Characteristics

Characteristics		Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage		V_F	$I_F = 10\text{mA}$	1.7	2	2.5	V
Reverse Current		I_R	$V_R = 6\text{V}$			5	μA
Luminous Intensity Per Segment	Red	I_V	$I_F = 5\text{mA}$	0.28	.56		mcd
	Green	I_V	$I_F = 10\text{mA}$	0.5	1		mcd
Luminous Intensity Matching Ratio	Red	$I_V - M$	$I_F = 5\text{mA}$			2.3	
	Green	$I_V - M$	$I_F = 10\text{mA}$			2.3	
Peak Emission Wave Length	Red	λ_P	$I_F = 10\text{mA}$		700		nm
	Green	λ_P	$I_F = 10\text{mA}$		565		nm
Spectral Line Half Width	Red	$\Delta\lambda$	$I_F = 10\text{mA}$		100		nm
	Green	$\Delta\lambda$	$I_F = 10\text{mA}$		30		nm

* AND343 Series, right hand decimal point
AND345 Series, left hand decimal point



AND340 Series

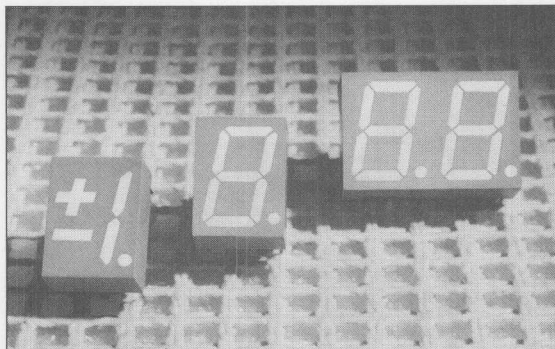
 I_F/SEG vs. V_F  I_{FMAX}/SEG vs. T_A  I_V vs. T_C  I_{FP} vs. D_R  I_V/SEG vs. D_R  I_V/SEG vs. I_F/SEG 

Outline Dimension (in millimeters)



AND344

Pin No.	Connection
1	Cathode D
2	Anode D
3	No Pin
4	Cathode C
5	Cathode E
6	Anode E
7	Anode C
8	Anode DP (right)
9	Cathode DP (right)
10	Cathode B
11	Cathode A
12	No Pin
13	Anode A
14	Anode B



FEATURES

- 0.56" character height
- Available in RED or GREEN
- Application: Numerical Readout for Instrument and Industrial products
- Industry pin for pin compatibility
- Both common cathode or common anode are available
- Single and Dual displays are available

Number of Digits	Common		Color		Number of Pins
	Cathode	Anode	Display	Face	
1	AND362R	AND363R	Red	Gray	10
1	AND362G	AND363G	Green	Gray	10
1/2	AND364R	AND365R	Red	Gray	10
1/2	AND364G	AND365G	Green	Gray	10
2	AND366R	AND367R	Red	Gray	18
2	AND366G	AND367G	Green	Gray	18

Absolute Maximum Ratings (T = 25°C)

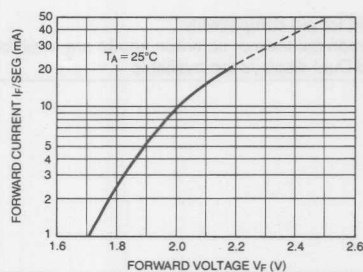
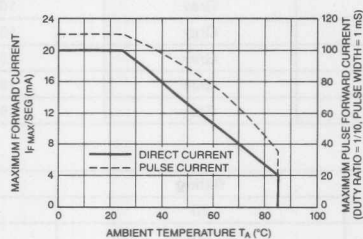
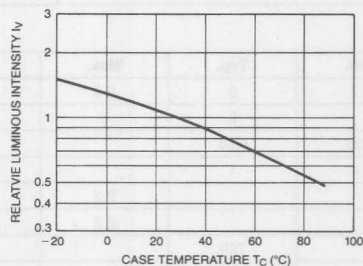
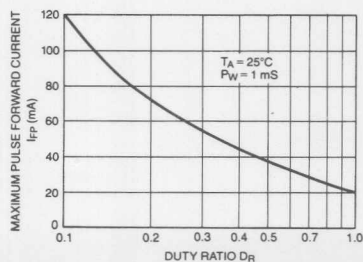
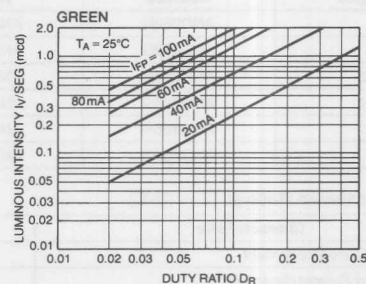
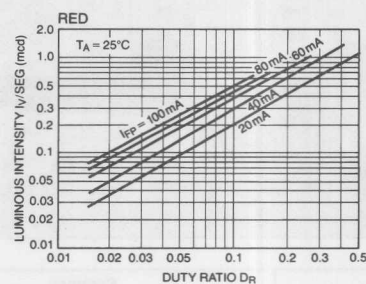
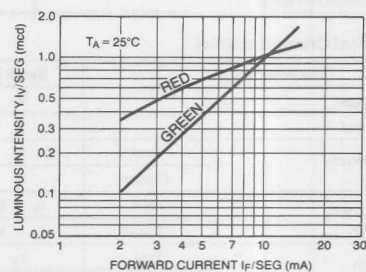
Characteristic	Symbol	Rating	Unit
DC Forward Current/Segment	$I_F(\text{DC})/\text{SEG}$	20	mA
Pulse Forward Current/Segment	I_{FP}/SEG	110	mA
Reverse Voltage/Segment	V_R	6	V
Operating Temperature Range	T_{opr}	-40 to 85	°C
Storage Temperature Range	T_{stg}	-40 to 85	°C

Electro-Optical Characteristics

Characteristics		Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage		V_F	$I_F = 10\text{mA}$	1.7	2	2.5	V
Reverse Current		I_R	$V_R = 6\text{V}$		5	5	μA
Luminous Intensity Per Segment	Red	I_V	$I_F = 5\text{mA}$	0.26	0.56		mcd
	Green	I_V	$I_F = 10\text{mA}$	0.4	1		mcd
Luminous Intensity Matching Ratio	Red	$I_V - M$	$I_F = 5\text{mA}$			2.3	
	Green	$I_V - M$	$I_F = 10\text{mA}$			2.3	
Peak Emission Wave Length	Red	λ_P	$I_F = 10\text{mA}$		700		nm
	Green	λ_P	$I_F = 10\text{mA}$		565		nm
Spectral Line Half Width	Red	$\Delta\lambda$	$I_F = 10\text{mA}$		100		nm
	Green	$\Delta\lambda$	$I_F = 10\text{mA}$		30		nm



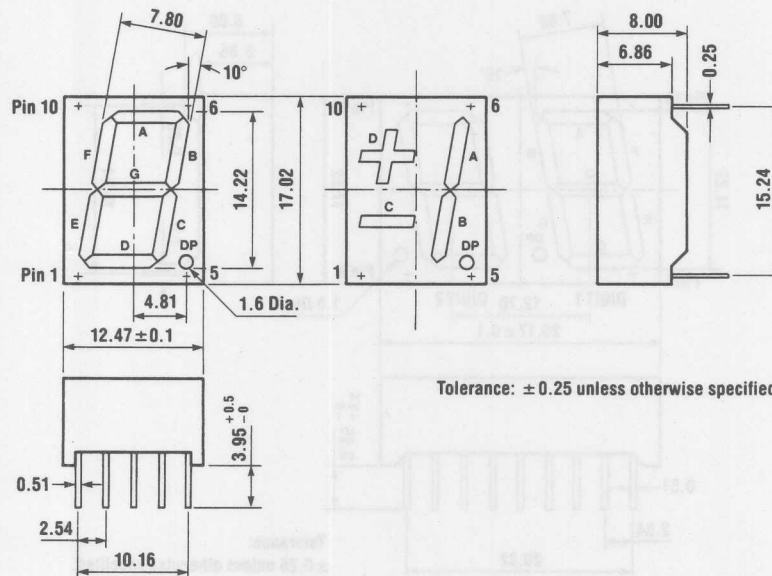
AND360 Series

 I_F/SEG vs. V_F  I_{FMAX}/SEG vs. T_A  I_V vs. T_C  I_{FP} vs. D_R  I_V/SEG vs. D_R  I_V/SEG vs. I_F/SEG 



AND360 Series

Outline Dimension (in millimeters)

Tolerance: ± 0.25 unless otherwise specified.

Pin Connection

AND362

Pin No.	Connection
1	Anode E
2	Anode D
3	Common Cathode
4	Anode C
5	Anode DP
6	Anode B
7	Anode A
8	Common Cathode
9	Anode F
10	Anode G

AND363

Pin No.	Connection
1	Cathode E
2	Cathode D
3	Common Anode
4	Cathode C
5	Cathode DP
6	Cathode B
7	Cathode A
8	Common Anode
9	Cathode F
10	Cathode G

AND364

Pin No.	Connection
1	Anode C
2	Cathode C, D
3	Anode B
4	Cathode A, B, DP
5	Anode DP
6	Anode A
7	Cathode A, B, DP
8	Cathode C, D
9	Anode D
10	No Pin

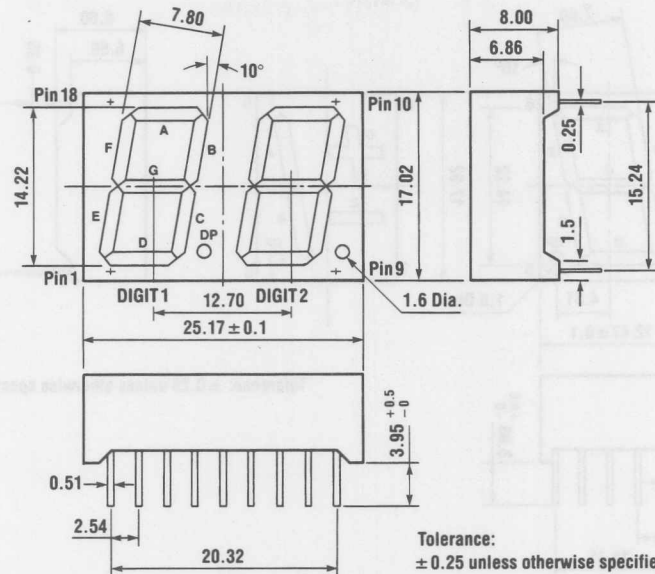
AND365

Pin No.	Connection
1	Cathode C
2	Anode C, D
3	Cathode B
4	Anode A, B, DP
5	Cathode DP
6	Cathode A
7	Anode A, B, DP
8	Anode C, D
9	Cathode D
10	No Pin



AND360 Series

Outline Dimension (in millimeters)



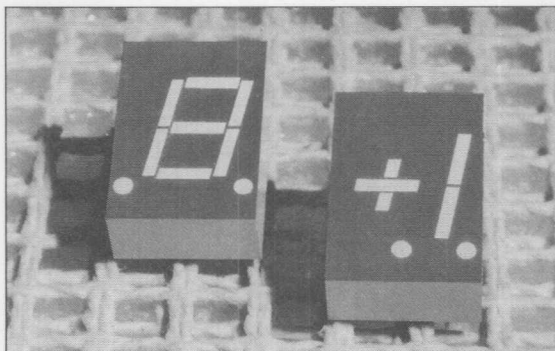
Pin Connection

AND366

Pin No.	Digit	Connection
1	1	Anode E
2	1	Anode D
3	1	Anode C
4	1	Anode DP
5	2	Anode E
6	2	Anode D
7	2	Anode G
8	2	Anode C
9	2	Anode DP
10	2	Anode B
11	2	Anode A
12	2	Anode F
13	2	Common Cathode
14	1	Common Cathode
15	1	Anode B
16	1	Anode A
17	1	Anode G
18	1	Anode F

AND367

Pin No.	Digit	Connection
1	1	Cathode E
2	1	Cathode D
3	1	Cathode C
4	1	Cathode DP
5	2	Cathode E
6	2	Cathode D
7	2	Cathode G
8	2	Cathode C
9	2	Cathode DP
10	2	Cathode B
11	2	Cathode A
12	2	Cathode F
13	2	Common Anode
14	1	Common Anode
15	1	Cathode B
16	1	Cathode A
17	1	Cathode G
18	1	Cathode F



FEATURES

- 0.3", 0.43" and 0.56" character heights
- Available in Super Bright RED
- Application: Numerical Readout for Instrument and Industrial products
- Industry pin for pin compatibility
- Both common cathode or common anode are available

	Number of Digits	Common		Color		Number of Pins
		Cathode	Anode	Display	Face	
.3 inch	1	AND332S		Red	Red	10
.3 inch	1		AND333S/AND335S*	Red	Red	14
.3 inch	1/2		AND334S	Red	Red	14
.43 inch	1	AND342S	AND343S/AND345S*	Red	Red	14
.43 inch	1/2		AND344S	Red	Red	14
.56 inch	1	AND362S	AND363S	Red	Red	10
.56 inch	1/2	AND364S	AND365S	Red	Gray	10

Absolute Maximum Ratings (T = 25°C)

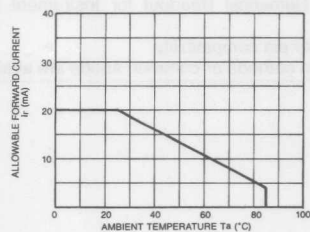
Characteristic	Symbol	Rating	Unit
DC Forward Current/Segment	$I_F(\text{DC})/\text{SEG}$	20	mA
Pulse Forward Current/Segment	I_{FP}/SEG	110	mA
Reverse Voltage/Segment	V_R	6	V
Operating Temperature Range	T_{opr}	-40 to +85	°C
Storage Temperature Range	T_{stg}	-40 to +85	°C

Electro-Optical Characteristics

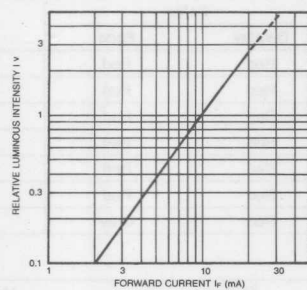
Characteristics	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage	V_F	$I_F = 10\text{mA}$	1.7	2	2.5	V_F
Reverse Current	I_R	$V_R = 6\text{V}$			5	μA
Luminous Intensity Per Segment						
AND33XS	I_V	$I_F = 10\text{mA}$	0.9	1.85		mcd
AND34XS	I_V	$I_F = 10\text{mA}$	0.6	1.28		mcd
AND36XS	I_V	$I_F = 10\text{mA}$	1.0	2.00		mcd
Luminous Intensity Matching Ratio	$I_V\text{-M}$	$I_F = 10\text{mA}$			2.3	
Peak Emission Wave Length	λ_P	$I_F = 10\text{mA}$		635		nm
Spectral Line Half Width	$\Delta\lambda$	$I_F = 10\text{mA}$		40		nm

* AND333/343 Series, right hand decimal point
AND335/345 Series, left hand decimal point

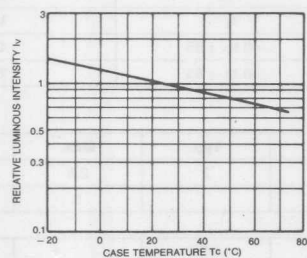
I_F vs. T_a



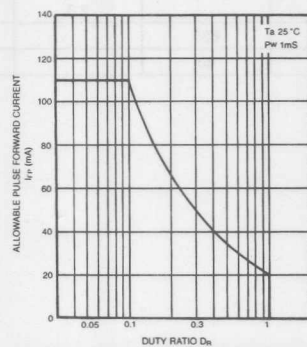
I_V vs. I_F



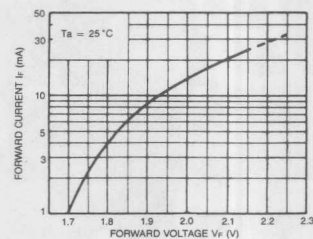
I_V vs. T_C



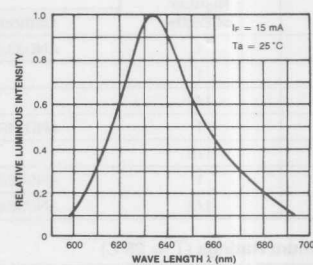
I_{FP} - D_R



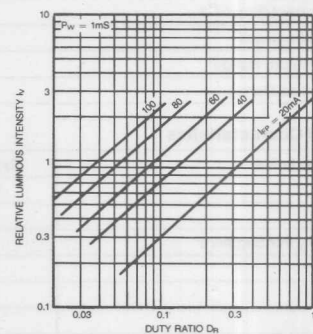
I_F vs. V_F



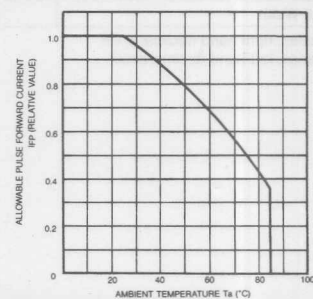
RELATIVE LUMINOUS INTENSITY—
WAVE LENGTH



I_V vs. D_R

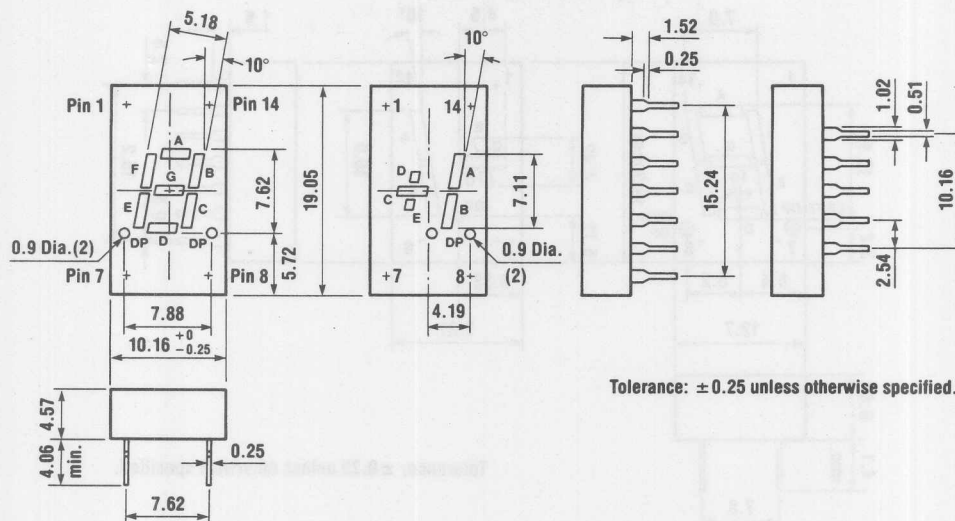


I_{FP} - T_a



AND330 Series

Outline Dimension (in millimeters)


Tolerance: ± 0.25 unless otherwise specified.

Pin Connection

AND332S

Pin No.	Connection
1	Common Cathode
2	Anode F
3	Anode G
4	Anode E
5	Anode D
6	Common Cathode
7	Anode DP (right)
8	Anode C
9	Anode B
10	Anode A

AND333S

Pin No.	Connection
1	Cathode A
2	Cathode F
3	Common Anode
4	No Pin
5	No Pin
6	No Connection
7	Cathode E
8	Cathode D
9	Cathode DP (right)
10	Cathode C
11	Cathode G
12	No Pin
13	Cathode B
14	Common Anode

AND335S

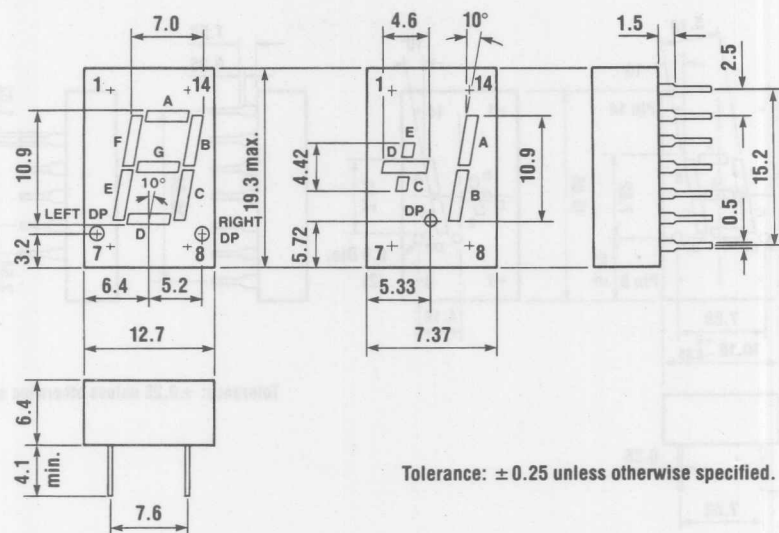
Pin No.	Connection
1	Cathode A
2	Cathode F
3	Common Anode
4	No Pin
5	No Pin
6	Cathode DP (left)
7	Cathode E
8	Cathode D
9	No Connection
10	Cathode C
11	Cathode G
12	No Pin
13	Cathode B
14	Common Anode

AND334S

Pin No.	Connection
1	Anode D
2	No Pin
3	Cathode D
4	Cathode C
5	Cathode E
6	Anode E
7	Anode C
8	Anode DP (right)
9	No Pin
10	Cathode DP (right)
11	Cathode B
12	Cathode A
13	Anode A
14	Anode B

AND340 Series

Outline Dimension (in millimeters)



Tolerance: ± 0.25 unless otherwise specified.

Pin Connection

AND342S

Pin No.	Connection
1	Anode A
2	Anode F
3	Common Cathode
4	No Pin
5	No Pin
6	No Connection
7	Anode E
8	Anode D
9	Anode DP (right)
10	Anode C
11	Anode G
12	No Pin
13	Anode B
14	Common Cathode

AND343S

Pin No.	Connection
1	Cathode A
2	Cathode F
3	Common Anode
4	No Pin
5	No Pin
6	No Connection
7	Cathode E
8	Cathode D
9	Cathode DP (right)
10	Cathode C
11	Cathode G
12	No Pin
13	Cathode B
14	Common Anode

AND345S

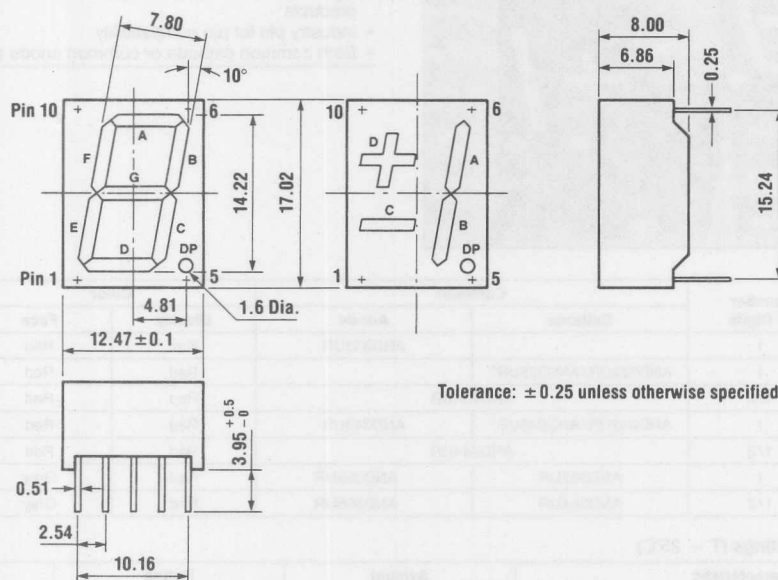
Pin No.	Connection
1	Cathode A
2	Cathode F
3	Common Anode
4	No Pin
5	No Pin
6	Cathode DP (left)
7	Cathode E
8	Cathode D
9	No Connection
10	Cathode C
11	Cathode G
12	No Pin
13	Cathode B
14	Common Anode

AND344S

Pin No.	Connection
1	Cathode D
2	Anode D
3	No Pin
4	Cathode C
5	Cathode E
6	Anode E
7	Anode C
8	Anode DP (right)
9	Cathode DP (right)
10	Cathode B
11	Cathode A
12	No Pin
13	Anode A
14	Anode B

AND360 Series

Outline Dimension (in millimeters)


Tolerance: ± 0.25 unless otherwise specified.

2

Pin Connection

AND362S

Pin No.	Connection
1	Anode E
2	Anode D
3	Common Cathode
4	Anode C
5	Anode DP
6	Anode B
7	Anode A
8	Common Cathode
9	Anode F
10	Anode G

AND363S

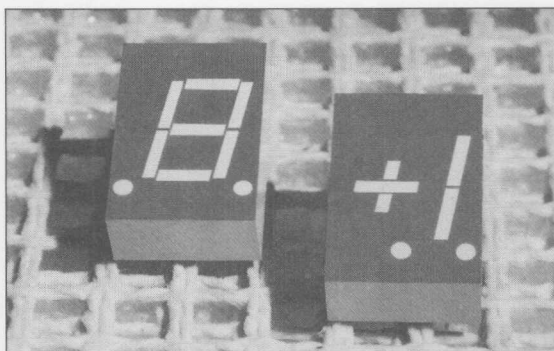
Pin No.	Connection
1	Cathode E
2	Cathode D
3	Common Anode
4	Cathode C
5	Cathode DP
6	Cathode B
7	Cathode A
8	Common Anode
9	Cathode F
10	Cathode G

AND364S

Pin No.	Connection
1	Anode C
2	Cathode C, D
3	Anode B
4	Cathode A, B, DP
5	Anode DP
6	Anode A
7	Cathode A, B, DP
8	Cathode C, D
9	Anode D
10	No Pin

AND365S

Pin No.	Connection
1	Cathode C
2	Anode C, D
3	Cathode B
4	Anode A, B, DP
5	Cathode DP
6	Cathode A
7	Anode A, B, DP
8	Anode C, D
9	Cathode D
10	No Pin



FEATURES

- 0.3", 0.43" and 0.56" character heights
- Available in Ultra Bright RED
- Application: Numerical Readout for Instrument and Industrial products
- Industry pin for pin compatibility
- Both common cathode or common anode are available

Size	Number of Digits	Common		Color		Number of Pins
		Cathode	Anode	Display	Face	
.3 inch	1		AND333UR	Red	Red	10
.3 inch	1	AND332UR/AND335UR*		Red	Red	14
.3 inch	1/2	AND334UR		Red	Red	14
.43 inch	1	AND342UR/AND345UR*		Red	Red	14
.43 inch	1/2	AND344UR		Red	Red	14
.56 inch	1	AND362UR	AND363UR	Red	Gray	10
.56 inch	1/2	AND364UR	AND365UR	Red	Gray	10

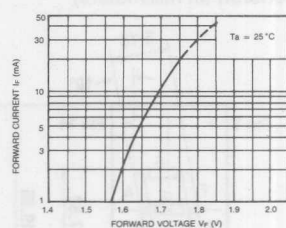
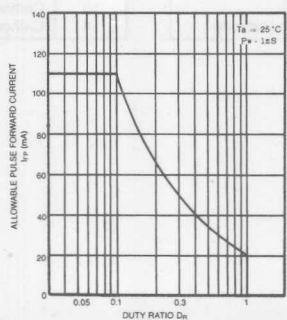
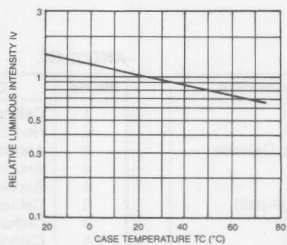
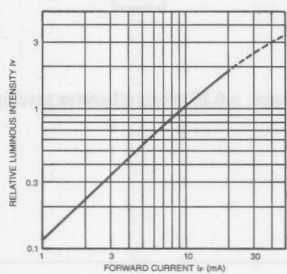
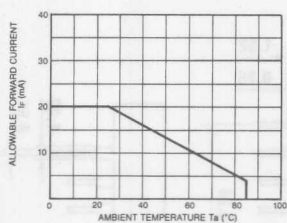
Absolute Maximum Ratings (T = 25°C)

Characteristic	Symbol	Rating	Unit
DC Forward Current/Segment	$I_F(\text{DC})/\text{SEG}$	20	mA
Pulse Forward Current/Segment	I_{FP}/SEG	110	mA
Reverse Voltage/Segment	V_R	6	V
Operating Temperature Range	T_{opr}	-40 to +85	°C
Storage Temperature Range	T_{stg}	-40 to +85	°C

Electro-Optical Characteristics

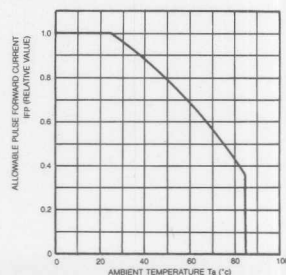
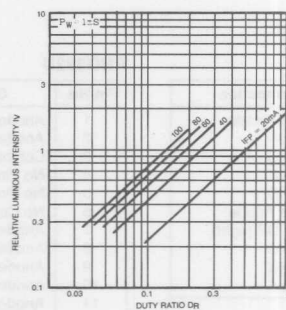
Characteristics	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage	V_F	$I_F = 10\text{mA}$	1.4	1.7	2.1	V_F
Reverse Current	I_R	$V_R = 6\text{V}$			5	μA
Luminous Intensity Per Segment						
AND33XUR	I_V	$I_F = 10\text{mA}$	0.64	1.92		mcd
AND34XUR	I_V	$I_F = 10\text{mA}$	0.44	1.32		mcd
AND36XUR	I_V	$I_F = 10\text{mA}$	0.88	2.13		mcd
Luminous Intensity Matching Ratio	$I_V\text{-M}$	$I_F = 10\text{mA}$			2.3	
Peak Emission Wave Length	λ_P	$I_F = 10\text{mA}$		660		nm
Spectral Line Half Width	$\Delta\lambda$	$I_F = 10\text{mA}$		25		nm

* AND333/343 Series, right hand decimal point
AND335/345 Series, left hand decimal point



A line graph showing the relative luminous intensity of a Ta filament lamp at 25°C as a function of wavelength. The x-axis is labeled 'WAVE LENGTH λ (nm)' and ranges from 620 to 720 with major grid lines every 20 nm and minor grid lines every 10 nm. The y-axis is labeled 'RELATIVE LUMINOUS INTENSITY' and ranges from 0 to 1.0 with major grid lines every 0.2 and minor grid lines every 0.1. The curve starts at approximately (635, 0.15), rises to a peak of 1.0 at 660 nm, and then falls to approximately (685, 0.15). The text 'Ta 25°C' is printed in the upper right area of the graph.

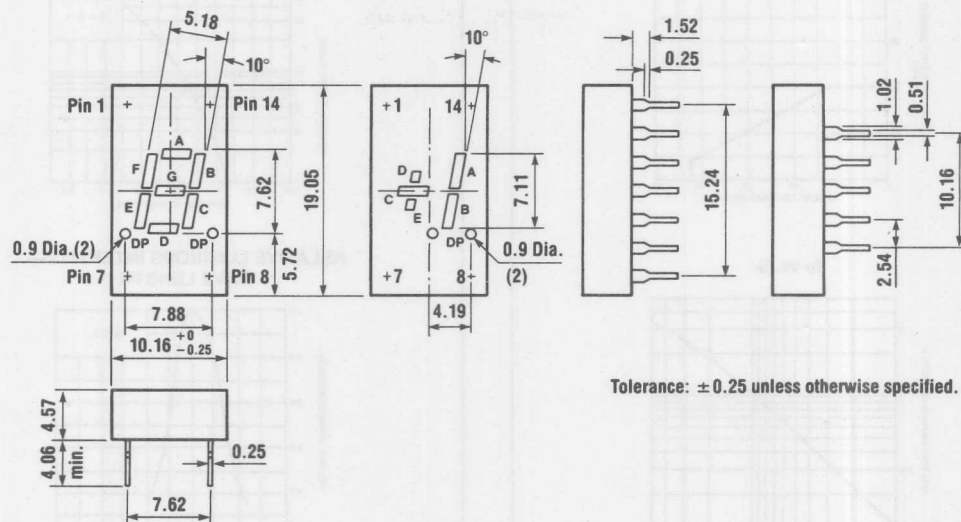
Wave Length λ (nm)	Relative Luminous Intensity
635	0.15
640	0.30
645	0.50
650	0.75
655	0.95
660	1.00
665	0.95
670	0.75
675	0.50
680	0.30
685	0.15





AND330 Series

Outline Dimension (in millimeters)

Tolerance: ± 0.25 unless otherwise specified.

Pin Connection

AND333U

Pin No.	Connection
1	Common Anode
2	Cathode F
3	Cathode G
4	Cathode E
5	Cathode D
6	Common Anode
7	Cathode DP (right)
8	Cathode C
9	Cathode B
10	Cathode A

AND332U

Pin No.	Connection
1	Anode A
2	Anode F
3	Common Cathode
4	No Pin
5	No Pin
6	No Connection
7	Anode E
8	Anode D
9	Anode DP (right)
10	Anode C
11	Anode G
12	No Pin
13	Anode B
14	Common Cathode

AND335U

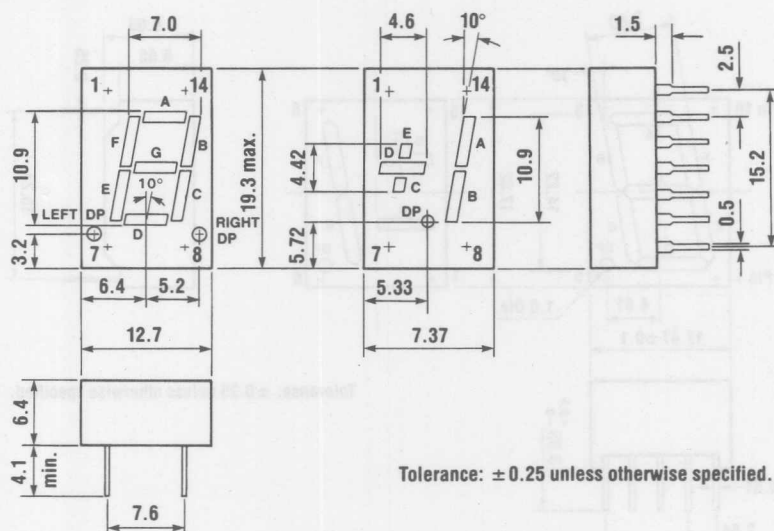
Pin No.	Connection
1	Anode A
2	Anode F
3	Common Cathode
4	No Pin
5	No Pin
6	Anode DP (left)
7	Anode E
8	Anode D
9	No Connection
10	Anode C
11	Anode G
12	No Pin
13	Anode B
14	Common Cathode

AND334U

Pin No.	Connection
1	Cathode D
2	No Pin
3	Anode D
4	Anode C
5	Anode E
6	Cathode E
7	Cathode C
8	Cathode DP (right)
9	No Pin
10	Anode DP (right)
11	Anode B
12	Anode A
13	Cathode A
14	Cathode B

AND340 Series

Outline Dimension (in millimeters)


Tolerance: ± 0.25 unless otherwise specified.

2

Pin Connection

AND342U

Pin No.	Connection
1	Anode A
2	Anode F
3	Common Cathode
4	No Pin
5	No Pin
6	No Connection
7	Anode E
8	Anode D
9	Anode DP (right)
10	Anode C
11	Anode G
12	No Pin
13	Anode B
14	Common Cathode

AND343U

Pin No.	Connection
1	Cathode A
2	Cathode F
3	Common Anode
4	No Pin
5	No Pin
6	No Connection
7	Cathode E
8	Cathode D
9	Cathode DP (right)
10	Cathode C
11	Cathode G
12	No Pin
13	Cathode B
14	Common Anode

AND345U

Pin No.	Connection
1	Anode A
2	Anode F
3	Common Cathode
4	No Pin
5	No Pin
6	Anode DP (left)
7	Anode E
8	Anode D
9	No Connection
10	Anode C
11	Anode G
12	No Pin
13	Anode B
14	Common Cathode

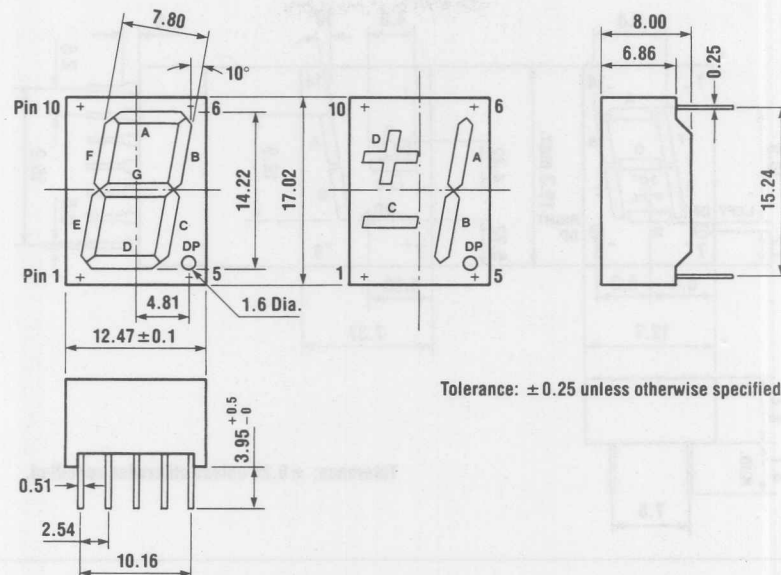
AND344U

Pin No.	Connection
1	Anode D
2	Cathode D
3	No Pin
4	Anode C
5	Anode E
6	Cathode E
7	Cathode C
8	Anode DP (right)
9	Anode DP (right)
10	Anode B
11	Anode A
12	No Pin
13	Cathode A
14	Cathode B



AND360 Series

Outline Dimension (in millimeters)

Tolerance: ± 0.25 unless otherwise specified.

Pin Connection

AND362U

Pin No.	Connection
1	Anode E
2	Anode D
3	Common Cathode
4	Anode C
5	Anode DP
6	Anode B
7	Anode A
8	Common Cathode
9	Anode F
10	Anode G

AND363U

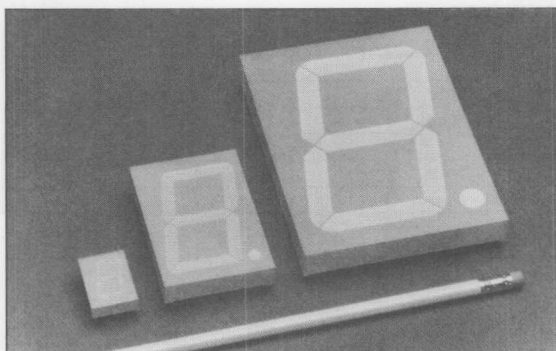
Pin No.	Connection
1	Cathode E
2	Cathode D
3	Common Anode
4	Cathode C
5	Cathode DP
6	Cathode B
7	Cathode A
8	Common Anode
9	Cathode F
10	Cathode G

AND364U

Pin No.	Connection
1	Anode C
2	Cathode C, D
3	Anode B
4	Cathode A, B, DP
5	Anode DP
6	Anode A
7	Cathode A, B, DP
8	Cathode C, D
9	Anode D
10	No Pin

AND365U

Pin No.	Connection
1	Cathode C
2	Anode C, D
3	Cathode B
4	Anode A, B, DP
5	Cathode DP
6	Cathode A
7	Anode A, B, DP
8	Anode C, D
9	Cathode D
10	No Pin



FEATURES

- LARGE size—7 segment Displays
- 0.8", 2.3", 4.0" character height
- Available in RED or GREEN
- Application: Large size displays for distance viewing.
Across the building status displays
- Both common cathode or common anode are available

Size	Number of Digits	Common		Color		Number of Pins
		Cathode	Anode	Display	Face	
.8 inch	1	AND8010SCL	AND8010SAL	Red	Red	16
.8 inch	1	AND8010GCL	AND8010GAL	Green	Gray	16
2.3 inch	1	AND2307SCL	AND2307SAL	Red	Red	10
2.3 inch	1	AND2307GCL	AND2307GAL	Green	Gray	10
4.0 inch	1	AND4107SCL	AND4107SAL	Red	Red	10
4.0 inch	1	AND4107GCL	AND4107GAL	Green	Gray	10

Absolute Maximum Ratings (T = 25°C)

Characteristic	Symbol	Rating All Others	Unit
DC Forward Current / Segment	I_F (DC) / SEG	30	mA
Reverse Voltage / Segment	V_R	6	V
Operating Temperature Range	T_{opr}	-25 to +85	°C
Storage Temperature Range	T_{stg}	-25 to +85	°C

Electro-Optical Characteristics

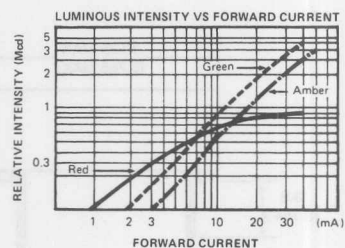
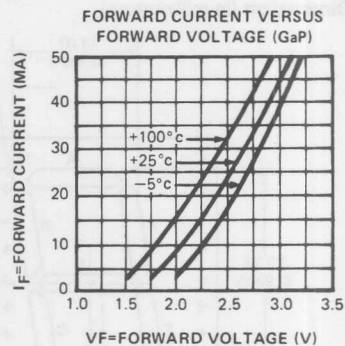
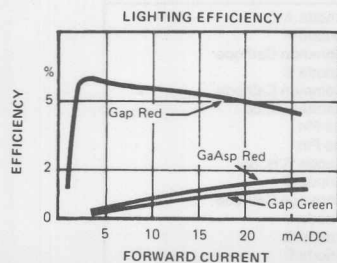
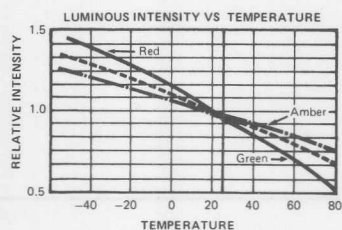
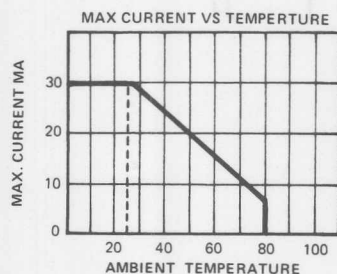
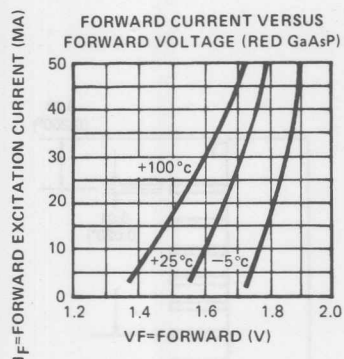
Characteristics	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage						
AND8010	V_F	$I_F = 10\text{mA}$		2.1	3	V
AND2307 Segment	V_F	$I_F = 20\text{mA}$		8.4	12.0	V
AND4107 Segment	V_F	$I_F = 40\text{mA}$		8.4	12.0	V
AND4107, AND2307 D.P.	V_F	$I_F = 10\text{mA}$		4.2	6.0	V
Reverse Current						
AND8010, AND2307	I_R	$V_R = 5\text{V}$			100	μA
AND4107 Segment	I_R	$V_R = 20\text{V}$.1	mA
D.P.	I_R	$V_R = 10\text{V}$.1	mA
Luminous Intensity Per Segment						
AND8010SXL Red	I_V	$I_F = 10\text{mA}$	1.26	1.8		mcd
AND8010GXL Green	I_V	$I_F = 10\text{mA}$	1.05	1.5		mcd
AND2307SXL Red	I_V	$I_F = 10\text{mA}$	0.77	1.1		mcd
AND2307GXL Green	I_V	$I_F = 10\text{mA}$	0.67	0.95		mcd
AND4107SXL Red	I_V	$I_F = 10\text{mA}$	1.01	1.42		mcd
AND4107GXL Green	I_V	$I_F = 10\text{mA}$.99	1.65		mcd



Electro-Optical Characteristics (Continued)

Characteristics		Symbol	Condition	Min.	Typ.	Max.	Unit
Peak Emission Wave Length							
AND8010SXL, AND2307SXL, AND4107SXL	Red	λ_P	$I_F = 20\text{mA}$		635		nm
AND8010GXL, AND2307GXL, AND4107GXL	Green	λ_P	$I_F = 20\text{mA}$		567		nm
Spectral Line Half Width							
AND8010SXL, AND2307SXL, AND4107SXL	Red	$\Delta\lambda$	$I_F = 20\text{mA}$		40		nm
AND8010GXL, AND2307GXL, AND4107GXL	Green	$\Delta\lambda$	$I_F = 20\text{mA}$		30		nm

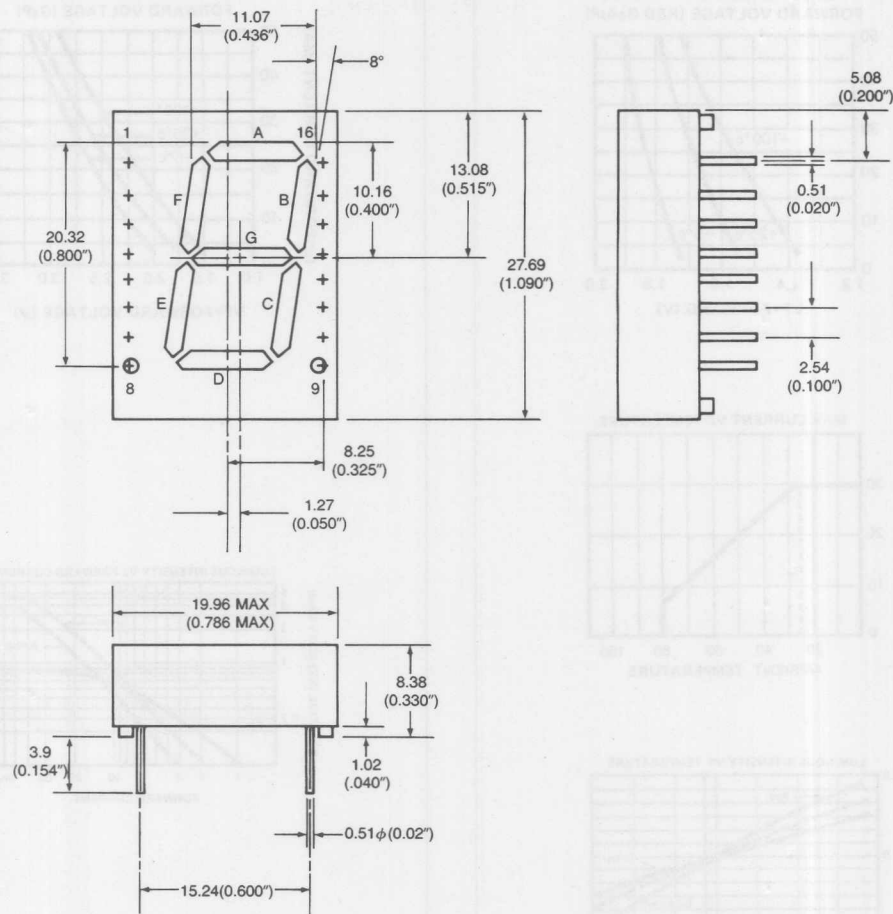
AND8000 Series





AND8010 Series

Outline Dimension (in millimeters)



Pin Connection

AND8010XAL

Pin No.	Connection
1	Cathode A
2	Cathode F
3	Common Anode
4	Cathode E
5	Common Anode
6	Cathode L.H. dp
7	No Pin
8	No Pin
9	Cathode R.H. dp
10	Cathode D
11	Common Anode
12	Cathode C
13	Cathode G
14	Cathode B
15	No Pin
16	Common Anode

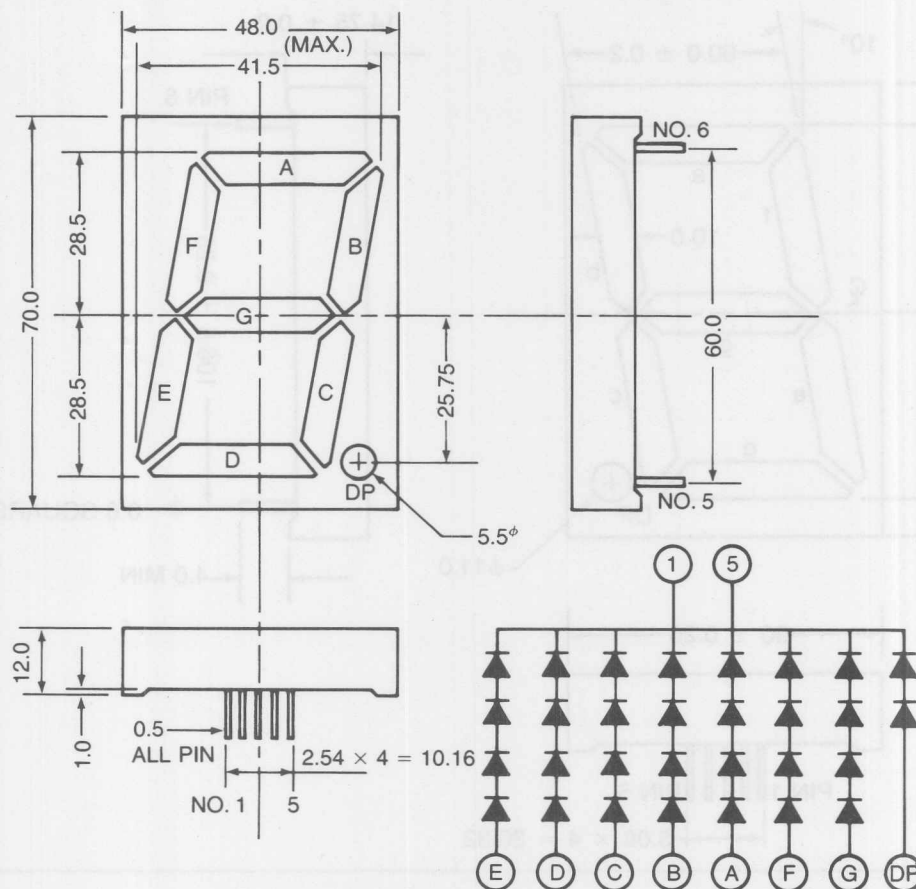
AND8010XCL

Pin No.	Connection
1	Anode A
2	Anode F
3	Common Cathode
4	Anode E
5	Common Cathode
6	Anode L.H. dp
7	No Pin
8	No Pin
9	Anode R.H. dp
10	Anode D
11	Common Cathode
12	Anode C
13	Anode G
14	Anode B
15	No Pin
16	Common Cathode



AND2307 Series

Outline Dimension (in millimeters)



Pin Connection

AND2307XAL

Pin No.	Connection
1	Common Anode
2	Cathode E
3	Cathode D
4	Cathode C
5	Common Anode
6	Cathode B
7	Cathode A
8	Cathode dp
9	Cathode F
10	Cathode G

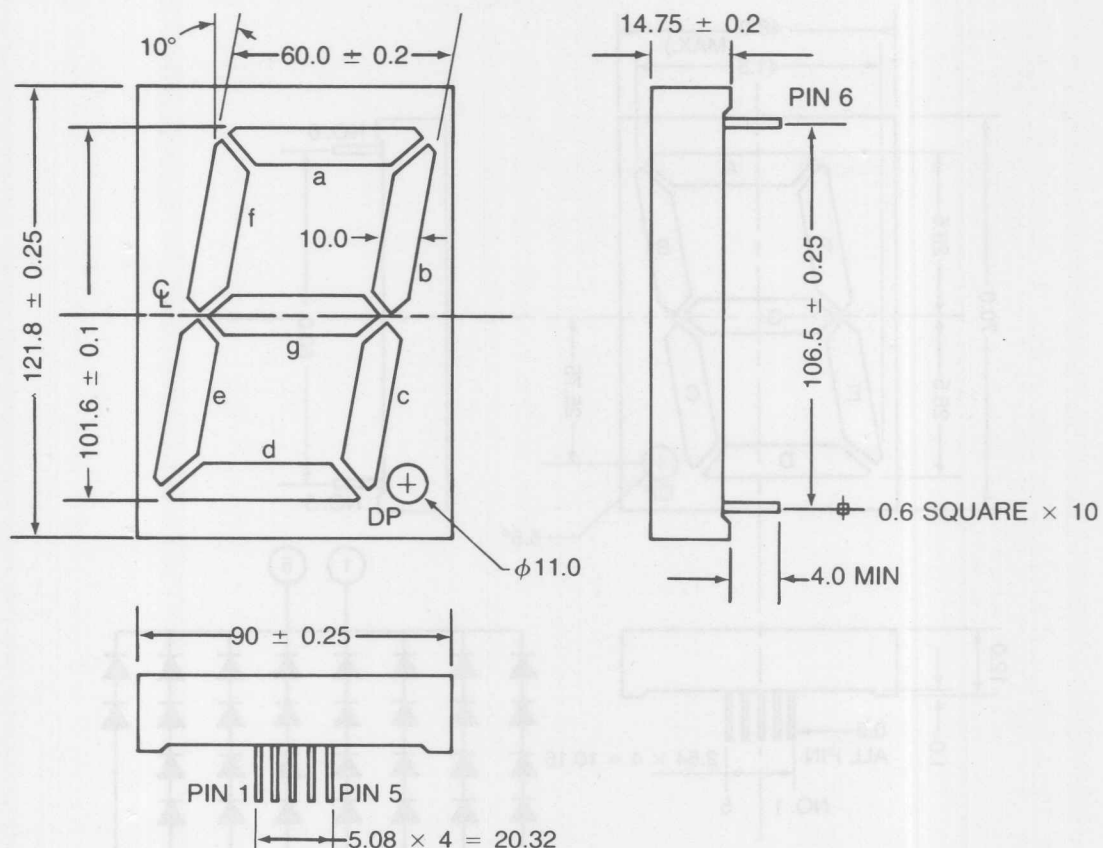
AND2307XCL

Pin No.	Connection
1	Common Cathode
2	Anode E
3	Anode D
4	Anode C
5	Common Cathode
6	Anode B
7	Anode A
8	Anode dp
9	Anode F
10	Anode G



AND4107 Series

Outline Dimension (in millimeters)



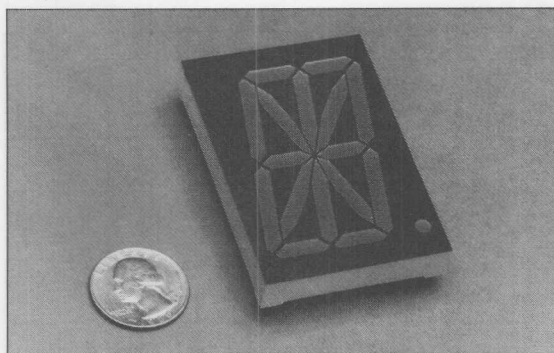
Pin Connection

AND4107XAL

Pin No.	Connection
1	Common Anode
2	Cathode E
3	Cathode D
4	Cathode C
5	Cathode dp
6	Cathode B
7	Cathode A
8	Common Anode
9	Cathode F
10	Cathode G

AND4107XCL

Pin No.	Connection
1	Common Cathode
2	Anode E
3	Anode D
4	Anode C
5	Anode dp
6	Anode B
7	Anode A
8	Common Cathode
9	Anode F
10	Anode G

**FEATURES**

- 16 segment ALPHANUMERIC displays
- 0.5", 0.54", 0.8", 2.3" character heights
- Available in RED or GREEN
- Application: Computer Peripherals and Terminal Displays for viewing at a DISTANCE
- Both common cathode or common anode are available

Size of Digits	Common		Color		Number of Pins
	Cathode	Anode	Display	Face	
.5 inch	AND370R	AND371R	Red	Red	18
.5 inch	AND370G	AND371G	Green	Green	18
.54 inch	AND5420CLB	AND5420ALB	Red	Red	18
.8 inch	AND8010SCLB	AND8010SALB	Red	Gray	18
.8 inch	AND8010GCLB	AND8010GALB	Green	Gray	18
2.3 inch	AND2316SCLB	AND2316SALB	Red	Red	20
2.3 inch	AND2316GCLB	AND2316GALB	Green	Black	20

Absolute Maximum Ratings (T = 25°C)

Characteristic	Symbol	Rating	Unit
DC Forward Current / Segment			
AND37X	I_F (DC) / SEG	15	mA
AND8010, 2316, 5420	I_F (DC) / SEG	30	mA
Pulse Forward Current / Segment			
AND37X (1ms Pulse - 10% Duty Cycle)	I_{FP} / SEG	80	mA
AND8010 (1us Pulse - .3% Duty Cycle)	I_{FP} / SEG	1000	mA
AND2316, 5420 (1us Pulse - 0.3% Duty Cycle)	I_{FP} / SEG	1000	mA
Reverse Voltage / Segment			
AND37X	V_R	3	V
Operating Temperature Range			
AND37X	T_{opr}	-30 to +75	°C
AND8010, AND2316, AND5420	T_{opr}	-25 to +85	°C
Storage Temperature Range			
AND37X	T_{stg}	-30 to +90	°C
AND8010, AND2316, AND5420	T_{stg}	-25 to +85	°C

Electro-Optical Characteristics

Characteristics	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage						
AND37X	V_F	$I_F = 15\text{mA}$	1.8	2.15	2.5	V
AND8010, 5420	V_F	$I_F = 20\text{mA}$		1.7	2	V
AND2316	Segment	$I_F = 20\text{mA}$		4.2	6	V
	Half-Segment	$I_F = 10\text{mA}$		4.2	6	V
	Decimal Point	$I_F = 10\text{mA}$		2.1	3	V

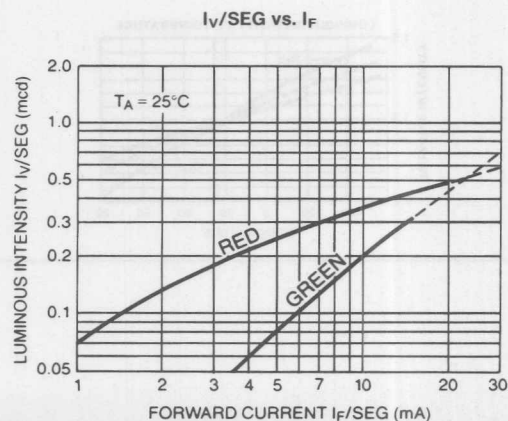
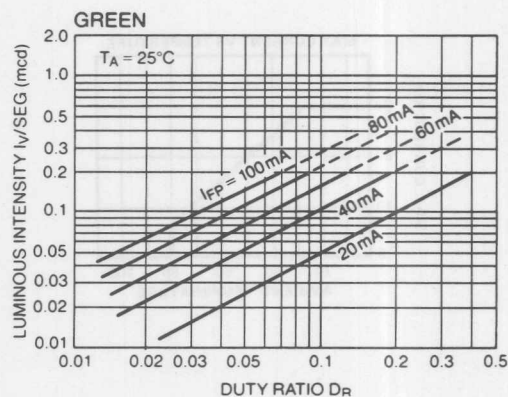
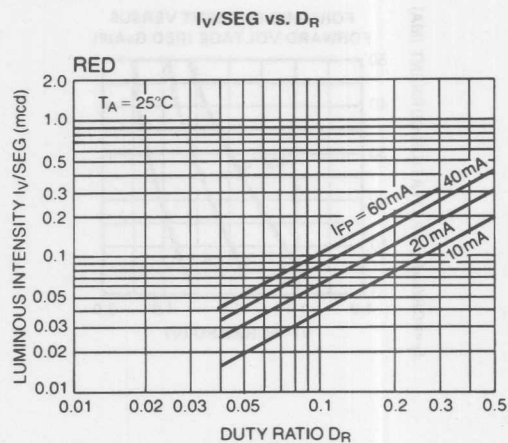
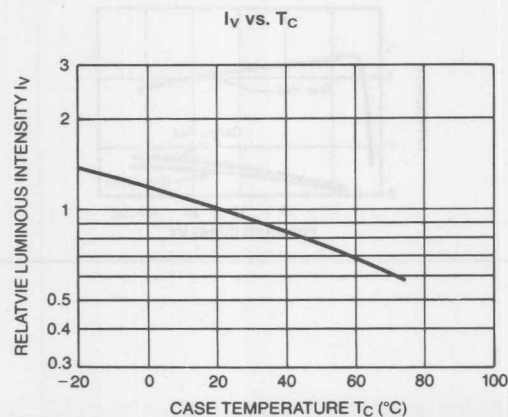
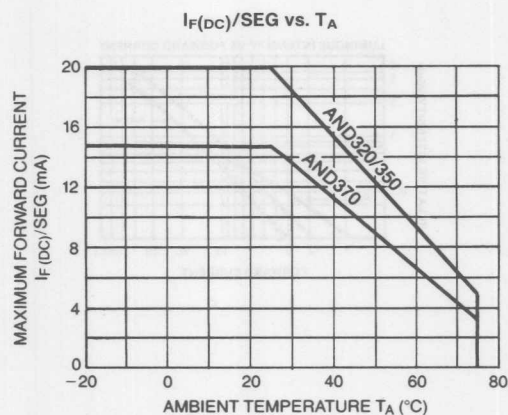
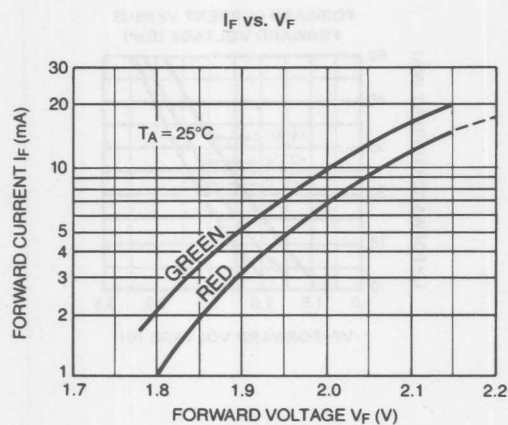


Electro-Optical Characteristics

Characteristics	Symbol	Condition	Min.	Typ.	Max.	Unit
Reverse Current						
AND37X	I_R	$V_R = 6V$			5	μA
AND8010, 5420	I_R	$V_R = 5V$			1	mA
AND2316	All Segments	$V_R = 10V$			0.2	mA
	Decimal Point	$V_R = 5V$			0.1	mA
Luminous Intensity/Segment						
AND37X	RED	$I_F = 5mA$	0.13	0.25		mcd
	GREEN	$I_F = 5mA$	0.13	0.2		mcd
AND8010, 5420	RED	$I_F = 10mA$	1.26	1.8		mcd
	GREEN	$I_F = 10mA$	0.7	1.0		mcd
AND2316	RED	$I_F = 10mA$	0.77	1.1		mcd
	GREEN	$I_F = 10mA$	0.67	0.95		mcd
Peak Emission Wave Length						
AND37X	RED	$I_F = 5mA$		700		nm
	GREEN	$I_F = 5mA$		565		nm
AND8010, 5420	RED	$I_F = 20mA$		635		nm
	GREEN	$I_F = 20mA$		567		nm
AND2316	RED	$I_F = 10mA$		635		nm
	GREEN	$I_F = 10mA$		567		nm
Spectral Line Half Width						
AND37X	RED	$I_F = 5mA$		100		nm
	GREEN	$I_F = 5mA$		30		nm
AND8010, 5420	RED	$I_F = 20mA$		45		nm
	GREEN	$I_F = 20mA$		30		nm
AND2316	RED	$I_F = 10mA$		45		nm
	GREEN	$I_F = 10mA$		30		nm

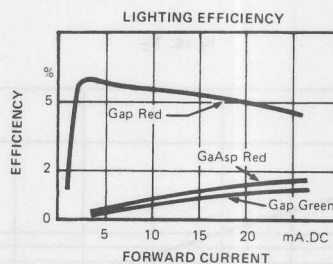
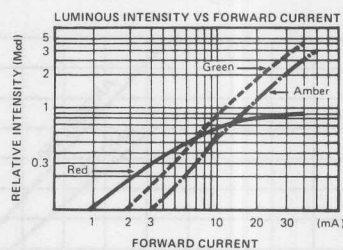
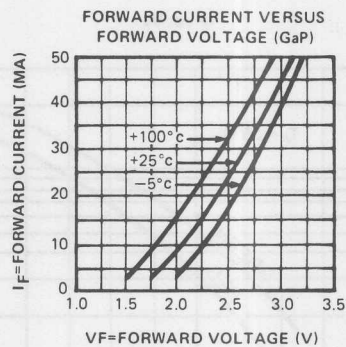
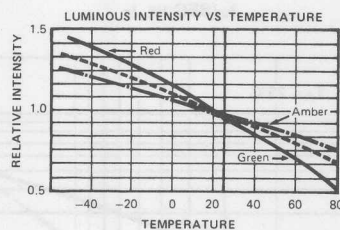
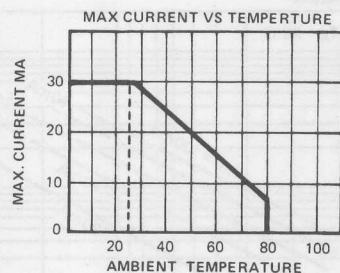
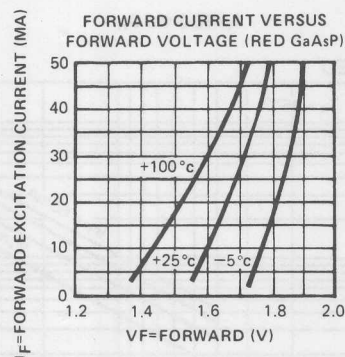


AND370 Series





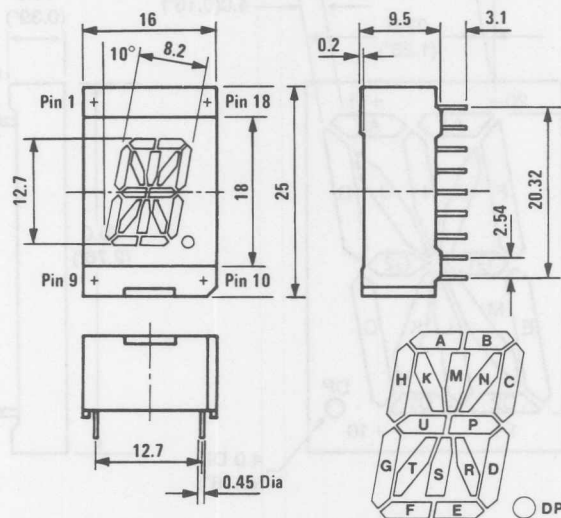
AND8010B / 2316B / 5420B Series





AND370 Series

Outline Dimension (in millimeters)



Pin Connection

AND370

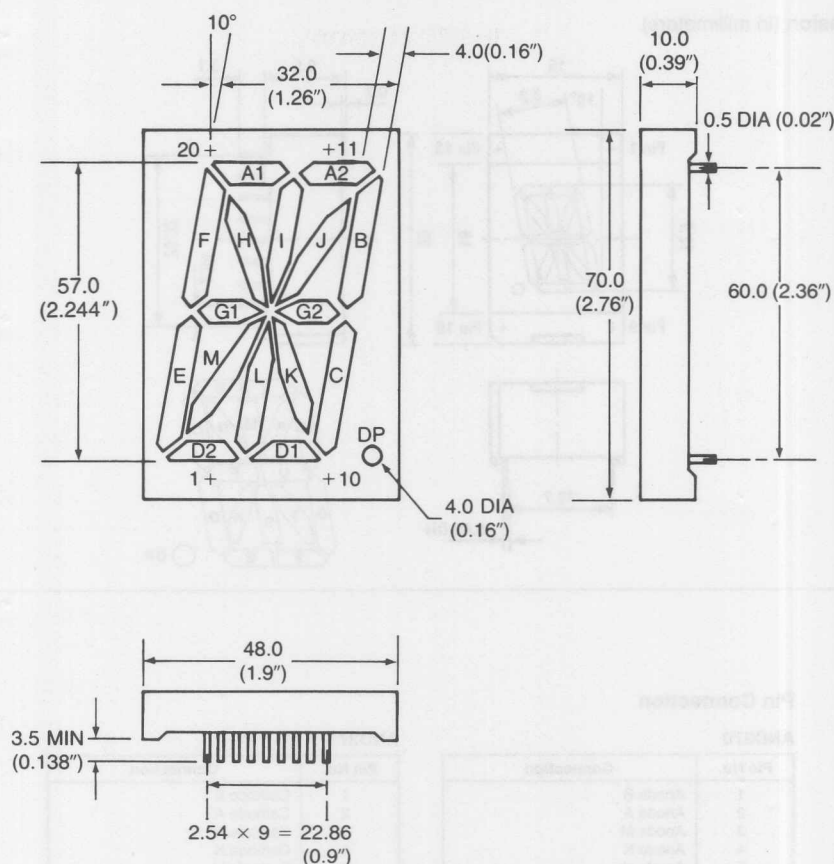
Pin No.	Connection
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2	Anode A
3	Anode M
4	Anode K
5	Anode H
6	Anode G
7	Anode T
8	Anode F
9	Anode E
10	Anode DP
11	Anode S
12	Anode R
13	Anode D
14	Anode U
15	Anode P
16	Anode C
17	Anode N
18	Common Cathode

AND371

Pin No.	Connection
1	Cathode B
2	Cathode A
3	Cathode M
4	Cathode K
5	Cathode H
6	Cathode G
7	Cathode T
8	Cathode F
9	Cathode E
10	Cathode DP
11	Cathode S
12	Cathode R
13	Cathode D
14	Cathode U
15	Cathode P
16	Cathode C
17	Cathode N
18	Common Anode



AND2316 Series



Pin Connection

AND2316XALB

Pin No.	Connection
1	Common Anode
2	Cathode G1
3	Cathode E
4	Cathode D2
5	Cathode M
6	Cathode L
7	Cathode D1
8	Cathode K
9	Cathode C
10	Cathode Dp
11	Common Anode
12	Cathode G2
13	Cathode B
14	Cathode A2
15	Cathode J
16	Cathode I
17	Cathode A1
18	Cathode H
19	Cathode F
20	No Pin

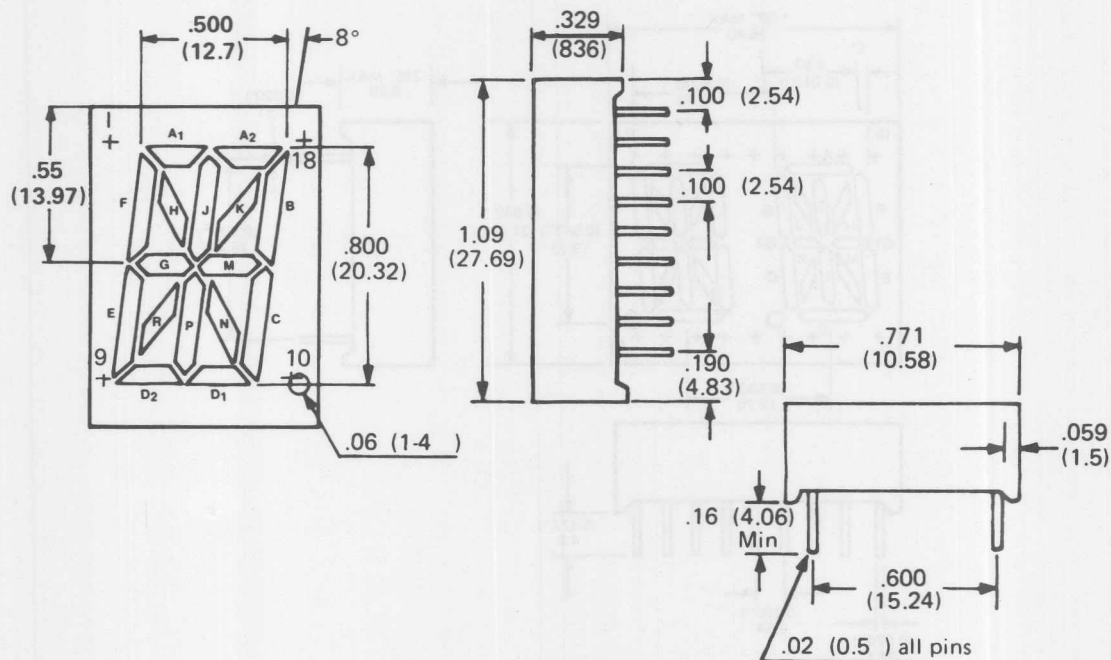
AND2316XCLB

Pin No.	Connection
1	Common Cathode
2	Anode G1
3	Anode E
4	Anode D2
5	Anode M
6	Anode L
7	Anode D1
8	Anode K
9	Anode C
10	Anode Dp
11	Common Cathode
12	Anode G2
13	Anode B
14	Anode A2
15	Anode J
16	Anode I
17	Anode A1
18	Anode H
19	Anode F
20	No Pin



AND8000 Series

Outline Dimension (in millimeters)



Pin Connection

AND8010XALB

Pin No.	Connection
1	A2 Seg. Cathode
2	A1 Seg. Cathode
3	F Seg. Cathode
4	H Seg. Cathode
5	E Seg. Cathode
6	J Seg. Cathode
7	P Seg. Cathode
8	R Seg. Cathode
9	N Seg. Cathode
10	D1 Seg. Cathode
11	D2 Seg. Cathode
12	Common Anode
13	C Seg. Cathode
14	G Seg. Cathode
15	B Seg. Cathode
16	M Seg. Cathode
17	Common Anode
18	K Seg. Cathode

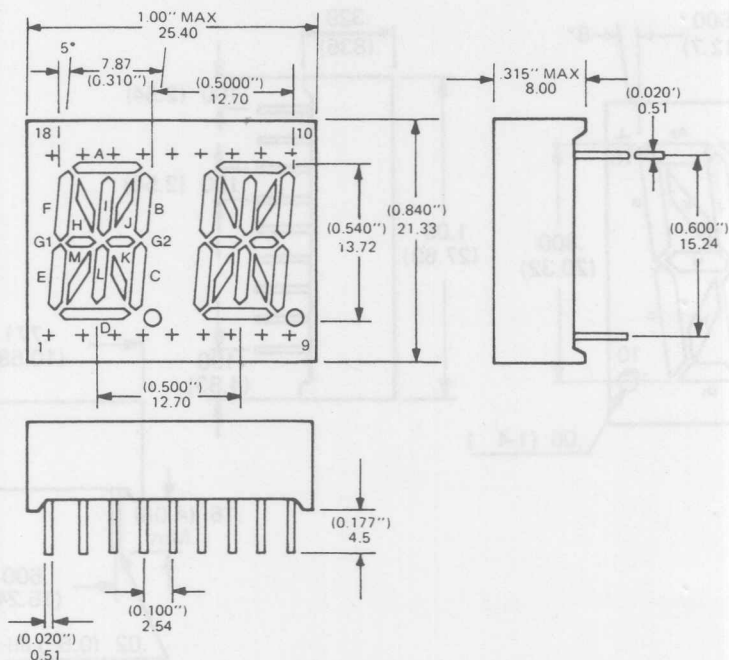
AND8010XCLB

Pin No.	Connection
1	A2 Seg. Anode
2	A1 Seg. Anode
3	F Seg. Anode
4	H Seg. Anode
5	E Seg. Anode
6	J Seg. Anode
7	P Seg. Anode
8	R Seg. Anode
9	N Seg. Anode
10	D1 Seg. Anode
11	D2 Seg. Anode
12	Common Cathode
13	C Seg. Anode
14	G Seg. Anode
15	B Seg. Anode
16	M Seg. Anode
17	Common Cathode
18	K Seg. Anode



AND5420 Series

Outline Dimension (in millimeters)



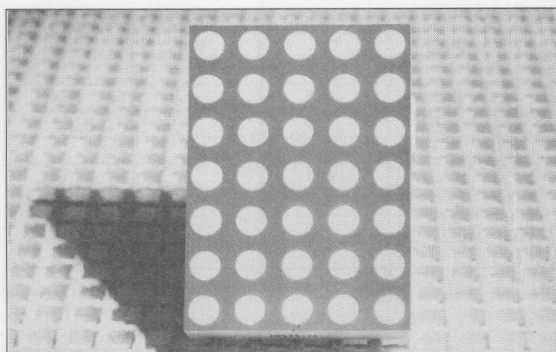
Pin Connection

AND5420OALB

Pin No.	Connection
1	E Cathode
2	M Cathode
3	No Connection
4	L Cathode
5	K Cathode
6	G2 Cathode
7	D Cathode
8	DP Cathode
9	C Cathode
10	B Cathode
11	Digit 2 Common Anode
12	A Cathode
13	G1 Cathode
14	J Cathode
15	I Cathode
16	Digit 1 Common Anode
17	H Cathode
18	F Cathode

AND5420OCLB

Pin No.	Connection
1	E Anode
2	M Anode
3	No Connection
4	L Anode
5	K Anode
6	G2 Anode
7	D Anode
8	DP Anode
9	C Anode
10	B Anode
11	Digit 2 Common Cathode
12	A Anode
13	G1 Anode
14	J Anode
15	I Anode
16	Digit 1 Common Cathode
17	H Anode
18	F Anode

**FEATURES**

- LARGE size—Dot Matrix Displays
- 2.0" character height
- Available in RED or GREEN
- Application: Large ALPHANUMERIC Displays for Instrumentation, status display, billboards.

Size of Digits	Common		Format	Color		Number of Pins
	Cathode Column	Cathode Row		Display	Face	
2.0	AND2570S	AND2571S	5 x 7	Red	Gray	14
2.0	AND2570G	AND2571G	5 x 7	Green	Gray	14

Absolute Maximum Ratings (T = 25°C)

Characteristic	Symbol	Rating	Unit
DC Forward Current/Segment			
AND257X	$I_F(\text{DC})/\text{SEG}$	30	mA
Pulse Forward Current/Segment*			
AND257X	I_{FP}/SEG	1000	mA
Operating Temperature Range			
AND257X	T_{opr}	-25 to 85	°C
Storage Temperature Range			
AND257X	T_{stg}	-25 to 85	°C

* $I_{Fmax} = 1000 \text{ mA}$, Duty Cycle = .3, Pulse Width = 1 usec.
 $I_{Fmax} = 160 \text{ mA}$, Duty Cycle = .15, Pulse Width = 1 msec.

Electro-Optical Characteristics

Characteristics	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage						
AND257X	V_F	$I_F = 10 \text{ mA}$		2	3	V
Reverse Current						
AND257X	I_R	$V_R = 3 \text{ V}$			100	μA

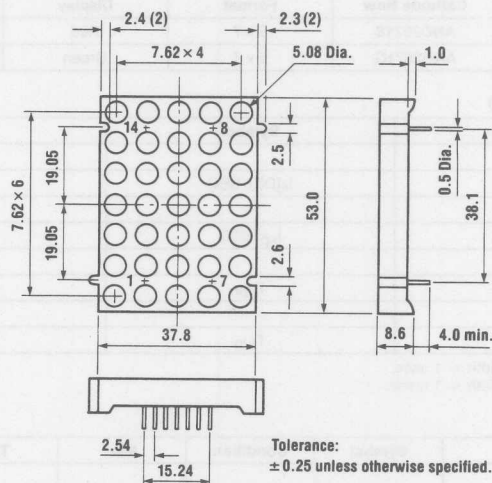


Electro-Optical Characteristics (Continued)

Characteristics	Symbol	Condition	Min.	Typ.	Max.	Unit
Luminous Intensity/Segment						
AND257XS	I_V	$I_F = 10\text{mA}$	650	950		μcd
AND257XG	I_V	$I_F = 10\text{mA}$	1120	1600		μcd
Peak Emission Wave Length						
AND257XS	λ_P	$I_F = 10\text{mA}$		635		nm
AND257XG	λ_P	$I_F = 10\text{mA}$		567		nm
Spectral Line Half Width						
AND257XS	$\Delta\lambda$	$I_F = 10\text{mA}$		100		nm
AND257XG	$\Delta\lambda$	$I_F = 10\text{mA}$		30		nm

AND2500 Series

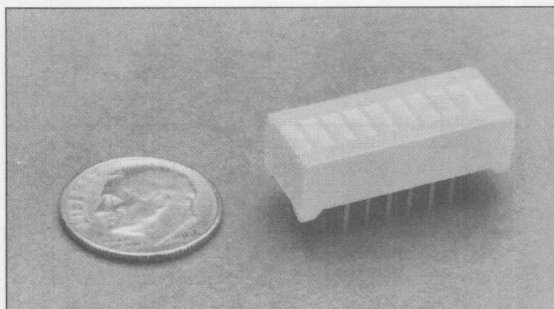
Outline Dimension (in millimeters)



Pin Connection

Pin No.	Function
1	Row 5
2	Row 7
3	Column 2
4	Column 3
5	Row 4
6	Column 5
7	Row 6

Pin No.	Function
8	Row 3
9	Row 1
10	Column 4
11	Column 3
12	Row 4
13	Column 1
14	Row 2



FEATURES

- New dual color 10 position bar graph
- 10 position bar graphs in red, green, and yellow
- Uniform brightness
- Applications: Status displays for Industrial and Instrumentation products

Number of Positions	Number of Rows	Dual Color			Number of Pins
		Red – Green			
10	1	AND10KHGL			12

Number of Positions	Number of Rows	Color			Number of Pins
		Red	Green	Yellow	
10	1	AND10KRL	AND10KGL	AND10KYL	20
10	1	AND10KSL	–	–	20
5	1	AND208-5R	AND208-5G	–	10

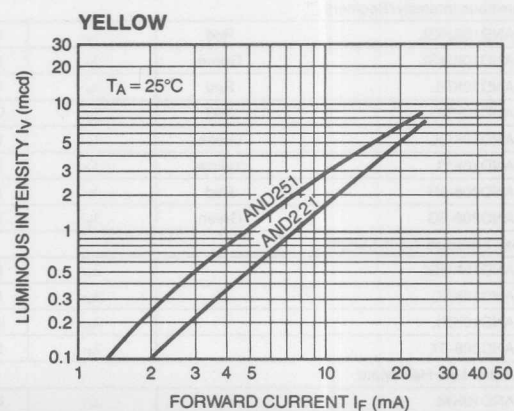
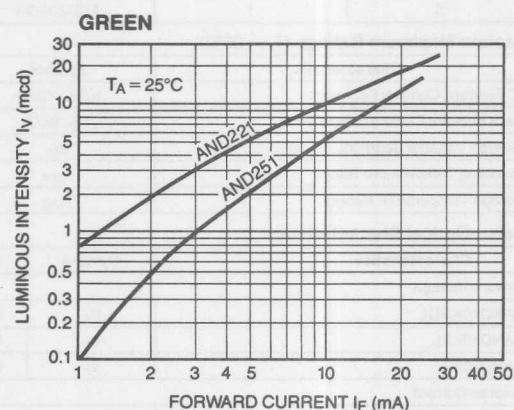
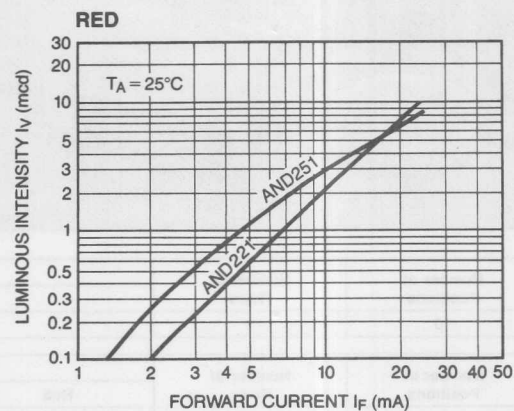
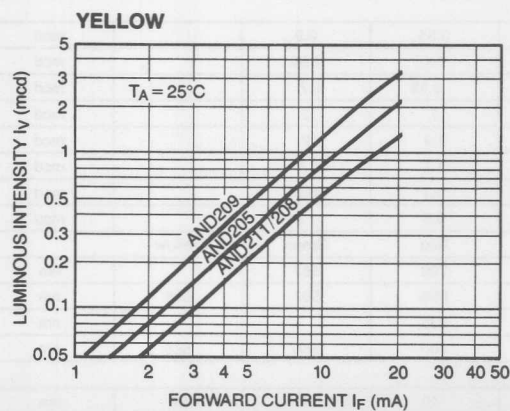
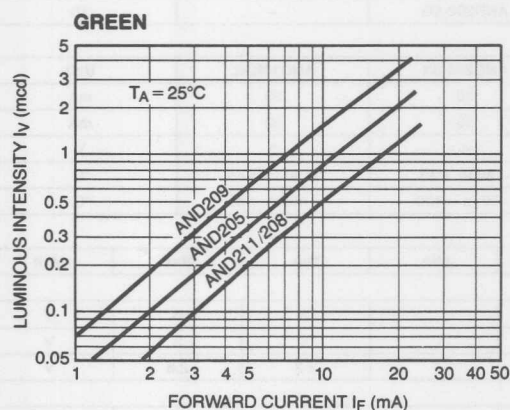
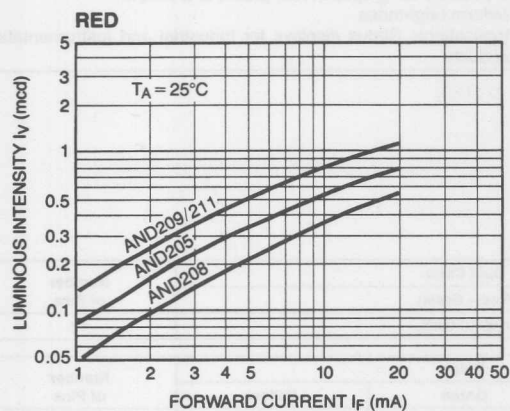
Absolute Maximum Ratings (T = 25°C)

Characteristic	Symbol	AND208-5X	AND10KXL	Unit
DC Forward Current/Segment	$I_F(\text{DC})/\text{SEG}$	20	30	mA
Pulse Forward Current/Segment	I_{FP}/SEG	25	30	mA
Reverse Voltage/Segment	V_R	4	5	V
Operating Temperature Range	T_{opr}	-20 to +75	-40 to +85	°C
Storage Temperature Range	T_{stg}	-30 to +100	-40 to +85	°C

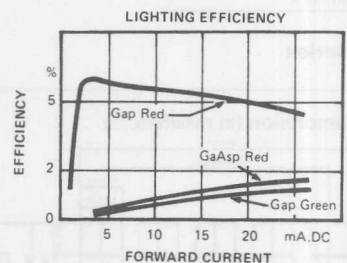
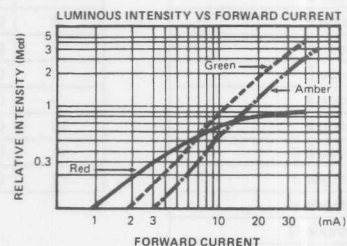
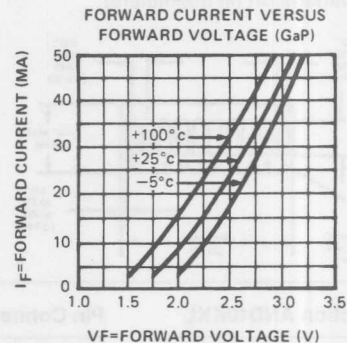
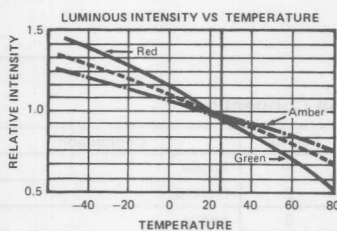
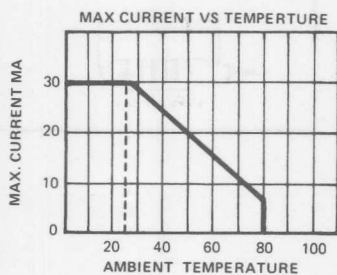
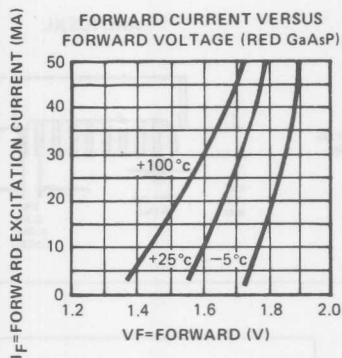
Electro-Optical Characteristics

Characteristics	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage						
AND10KHGL	V_F	$I_F = 20\text{mA}$		2	3	V
AND10KXL	V_F	$I_F = 10\text{mA}$		2	3	V
AND208-5	V_F	$I_F = 20\text{mA}$		2.2	2.8	V
Reverse Current						
AND10KHGL	I_R	$V_R = 5\text{V}$			100	μA
AND10KXL, AND208-5	I_R	$V_R = 4\text{V}$			100	μA
Luminous Intensity/Segment						
AND10KHGL	Red	$I_F = 10\text{mA}$	0.54	0.9		mcd
AND10KHGL	Green	$I_F = 10\text{mA}$	1.1	1.85		mcd
AND10KRL	Red	$I_F = 15\text{mA}$	0.49	0.7		mcd
AND10KSL	Red	$I_F = 15\text{mA}$	1	2		mcd
AND10KGL	Green	$I_F = 15\text{mA}$	1.4	2		mcd
AND10KYL	Yellow	$I_F = 15\text{mA}$	1.1	1.7		mcd
AND208-5R	Red	$I_F = 15\text{mA}$	0.3	0.6		mcd
AND208-5G	Green	$I_F = 15\text{mA}$	0.5	1.2		mcd
Peak Emission Wave Length						
AND10KHGL	λ_P	$I_F = 10\text{mA}$	700	567		nm
AND10KXL	λ_P	$I_F = 10\text{mA}$	655	567	585	nm
AND10KSL	λ_P	$I_F = 10\text{mA}$	635			nm
AND208-5X	λ_P	$I_F = 15\text{mA}$	700	565	585	nm
Spectral Line Half Width						
AND10KXL	$\Delta\lambda$	$I_F = 10\text{mA}$	40	30	35	nm
AND208-5X	$\Delta\lambda$	$I_F = 15\text{mA}$	100	35	30	nm

AND208-5 Series



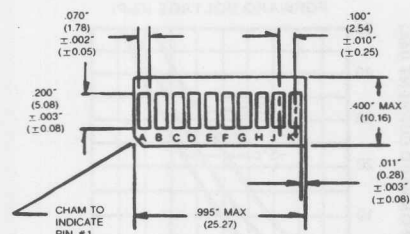
AND10K Series



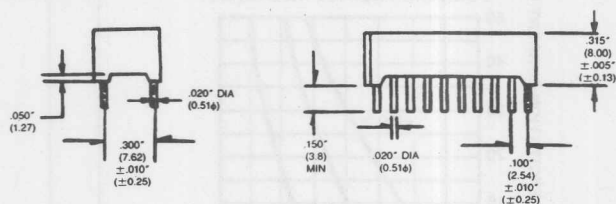


AND10K Series

Outline Dimension (in millimeters)



AND10KXL



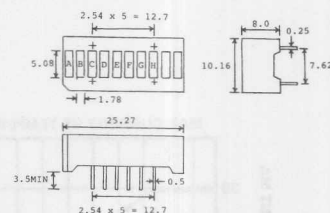
Pin Connection AND10KXL

Pin No.	Connection
1	Anode A
2	Anode B
3	Anode C
4	Anode D
5	Anode E
6	Anode F
7	Anode G
8	Anode H
9	Anode J
10	Anode K
11	Cathode K
12	Cathode J
13	Cathode H
14	Cathode G
15	Cathode F
16	Cathode E
17	Cathode D
18	Cathode C
19	Cathode B
20	Cathode A

Pin Connection AND10KHGL

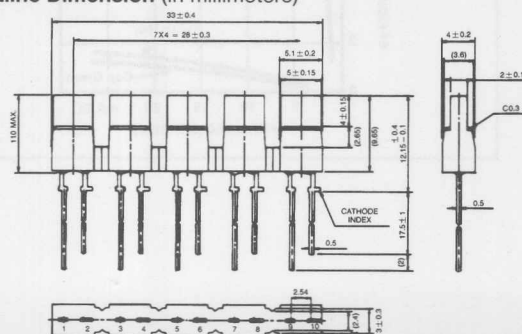
Pin No.	Connection
1	Cathode A
2	Cathode B
3	Cathode C
4	Cathode D
5	Cathode E
6	Common Anode (Red)
7	Cathode K
8	Cathode J
9	Cathode H
10	Cathode G
11	Cathode F
12	Common Anode (Green)

AND10KHGL



AND208-5 Series

Outline Dimension (in millimeters)



Pin Connection

Pin No.	Connection
1	Anode
2	Cathode
3	Anode
4	Cathode
5	Anode
6	Cathode
7	Anode
8	Cathode
9	Anode
10	Cathode



Quick Reference Guide	3-2
Ordering Information—Viewing Mode Selection Guide	3-3
General Specifications	3-4
Triplex Specifications	3-5
Product Data	3-6
Custom LCD Guidelines	3-17



Display Font	Digit Height (inches)	Part Number	Package Dimensions (inches) (L) (W)	Mechanical Data see page
	0.5	FE1901	1.2 x 1.2	3-16
	0.2 0.5 0.7 1.0	FE2201 FE0201 FE0501 FE0701	1.6 x 0.7 2.0 x 1.2 2.75 x 1.5 3.7 x 1.8	3-16 3-6 3-11 3-12
	0.5	FE0203	2.0 x 1.2	3-7
	0.4	FE0801	2.0 x 0.95	3-13
	0.3	FE0101	1.57 x 0.7	3-6
	0.35 0.5 0.5 0.7 1.0	FE0804 FE0202 FE0204M FE0502 FE0703	2.0 x 0.95 2.0 x 1.2 2.0 x 1.2 2.75 x 1.5 3.7 x 1.8	3-15 3-7 3-8 3-11 3-13
	0.5	FE0205	2.0 x 1.2	3-8
	0.4	FE0206	2.0 x 1.2	3-9
	0.4	FE0802	2.0 x 0.95	3-14
	0.4	FE0208	2.0 x 1.2	3-9
	0.5 0.7 0.3	FE0401 FE0601 FE0803	2.75 x 1.2 3.7 x 1.5 2.0 x 0.95	3-10 3-12 3-14
	0.5	FE1001	3.7 x 1.2	3-15
	0.15	FE0405	2.75 x 1.2	3-10

Electro-optical Data on Pages 3-4 and 3-5



Ordering Information

1. Select model number.
2. Select connector type (see configuration chart).
3. Select viewing mode (see configuration chart).
4. Consult factory to verify any additional options.
5. Consult factory for availability of selected configuration.

Configuration Chart

Viewing Mode	Configuration	
	Pinned	Pinless
Transmissive	A	F
Reflective Frosted (No Wide Temp.)	K	
Reflective Aluminum Foil	D	I
Transflective	E	J

Part Number **FEXXXX X-XX**

Model Number: _____

Liquid Crystal Material—Polarizer Options: _____

Leave digit blank—Standard Grade (–20 to +60°C)—Standard Polarizer

W-U—Wide Temperature (–30 to +85°C)—High Temp./High Humidity Polarizer

Viewing Mode (see configuration chart): _____

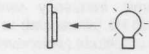
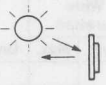
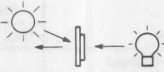
Example: Model FE0203, with wide temperature fluid, pinned reflective foil configuration and high temp./high humidity polarizer: FE0203W-DU

Viewing Mode Selection Guide

The LCD is unique when compared with other display technologies with respect to the method employed to produce the display image. The twisted nematic LCD does not generate light, it controls ambient light. Accordingly, the contrast will change proportionally to the ambient light level. As the ambient light increases, the optical characteristics of the display improve.

Conversely, when the ambient light level is reduced (below average indoor lighting) the display must be illuminated. This can be accomplished by the implementation of front or back light systems. Unfortunately, all lighting systems (unlike the LCD) consume power and therefore, should be used sparingly and only when absolutely necessary.

Viewing Mode Guidelines

Viewing Mode	 Transmissive	 Frosted Reflector	 Transflective
Description of Mode	Does not use a reflecting surface. Illuminated by a light source located behind the display (backlighting).	Uses a reflective surface to reflect ambient light back through the Liquid crystal materials for illumination.	Uses a partially reflecting surface. Can be viewed using either reflecting light or by the use of backlighting.
Advantage	<ul style="list-style-type: none">• Allows for backlighting• Offers the customer the option of using their choice of reflector or background material	<ul style="list-style-type: none">• Less shadow effect (aesthetic)• Textured background reflects light in a diffused manner. This produces higher off-angle reflection <p>Note: Referred to as rough, sandpaper appearance, grainy textured</p>	<ul style="list-style-type: none">• Display can be back light for low ambient light viewing
Disadvantage	Reduced viewing angle. Some shadow or parallax effect	Lower contrast ratio than foil when viewed straight on	Lowest ambient contrast ratio due to semi-translucent background

Note: Viewer will notice a slight loss in viewing angle and contrast when viewing the display in the backlit mode.

Note: To orient the LCD correctly, the fill seal should be located on the left side.
If no fill seal is visible, a white dot designates pin 1.



Electro-Optical, Environmental and Mechanical

Absolute Maximum Ratings (Polarizers Attached)

Parameter	Liquid Crystal Material		Unit
	Standard Temperature	"W" Wide Temperature	
Applied Voltage	10	10	V _{RMS}
DC Drive Component Allowable	25	50	mV
Operating Temperature	-20 to +60	-30 to +85	°C
Storage Temperature	-20 to +60	-40 to +85	°C
Operating Frequency	+30 to +100	+30 to +100	Hz

Note:

- A. Upper limits achieved with high temperature "U" sheet polarizers (not available with frosted reflector). With standard temperature polarizers, high temperature operation and storage is recommended not to exceed +60°C over extended periods of time.
- B. Flicker may occur below 30 Hz; power consumption increases above 100 Hz.

Recommended Operating Conditions (Polarizers Attached)

Parameter	Liquid Crystal Material						Unit
	Standard Temperature			“W” Wide Temperature			
	Min.	Typ.	Max.	Min.	Typ.	Max.	
Operating Voltage	3.0	5.0	6.0	3.5	5.0	6.0	V _{RMS}
Operating Frequency	30	32	35	30	32	100	Hz
Operating Temperature	-10	+25	+60	-30	+25	+85	°C

Typical Operating Characteristics (5 VRMS, 32 Hz, 25°C)

Parameter	Liquid Crystal Material						Unit
	Standard Temperature			“W” Wide Temperature			
	Min.	Typ.	Max.	Min.	Typ.	Max.	
Operating Current							
0.5" Character Height	–	1.0			1.0		μA/ Digit
0.7" Character Height	–	3.0			3.0		μA/ Digit
1.0" Character Height	–	6.0			6.0		μA/ Digit
Optical Response Time							
Rise Time (Ta = 50/60°C)	–	15	–		3		mS
Decay Time (Ta = 50/60°C)	–	60	–		10		mS
Rise Time (Ta = 25°C)	–	25	–		5		mS
Decay Time (Ta = 25°C)	–	90	–		25		mS
Rise Time (Ta = 0°C)	–	120	–		15		mS
Decay Time (Ta = 0°C)	–	400	–		65		mS
Contrast Ratio	–	20:1	–		18:1		–
Viewing Angle	–	±60°	–		±60°		
DC Resistance	–	100	–		100		MΩ
Expected Life		50000			100000		Hours

All AND LCDs will meet or exceed the above electro/optical, environmental and mechanical specifications.

Environmental Test Specifications

Parameter	Standard Temperature	"W" Wide Temperature
High Temperature Storage RH < 30%	60°C, 500 Hours	60°C, 500 Hours
Low Temperature Storage	-20°C, 500 Hours	-20°C, 500 Hours
Moisture Resistant 80°C, 95%	100 Hours without polarizer 500 Hours 240 Hours	100 Hours without polarizer 500 Hours 500 Hours
High Temperature Operation 10 V _{RMS} , 32 Hz Square Wave	60°C, 500 Hours	80°C, 500 Hours
Temperature Cycling (air to air, 10 cycles)	-20°C, 20 Minutes 60°C, 20 Minutes	20°C, 20 Minutes 85°C, 20 Minutes

Note: High stability "U" Polarizer not available with reflective silver bead backing.

Mechanical Specifications

Parameter	Min.	Typ.	Max.	Unit
Mechanical Shock: Mechanical shock consisting of 300 Gs @ .5 milliseconds in three mutually perpendicular axes. The LCD is fixed in position on its front surface.		1		Cycle
Thermal Shock (without polarizer) 2 minutes @ °C, 2 minutes @ 80°C (in the water) transfer time not to exceed 15 seconds.		5		Cycles
Vibration One Logarithmic frequency sweep from 10 to 2000 Hz (sinusoidal) at 20 Gs, or 1.5 mm amplitude (whichever is smaller) during a 20 minute time period. One sweep is required in each of three mutually perpendicular axes. The LCD is fixed in position on its front surface.		1		Sweep
Connector Pin Bend Test (Exceeds MIL-STND-883): With an 8 ounce weight attached to the pins, the pin must exceed three 90° bends before breaking.		3		Bends
UV Radiation: 1.5 mW/cm² UV Radiation (3650 black light) 1 all ≤ 200%		240		Hours

Electro-Optical, Environmental and Mechanical

Absolute Maximum Ratings (Polarizers Attached)

Parameter	Standard Temperature	Unit
Applied Voltage	10	V _{rms}
DC Drive Component Allowable	50	mV
Operating Temperature	0 to +60	°C
Storage Temperature	-20 to +60	°C
Frame Frequency	200	Hz

Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Unit
Operating Voltage		5.0±0.25		V _{rms}
Frame Frequency	100	—	200	Hz
Operating Temperature	0	25	50	C

Typical Operating Characteristics

Parameter	Min.	Typ.	Max.	Unit
Operating Current				
0.5" Character Height	—	4.0	8.0	μA/Cell
Optical Response Time				
Rise Time (Ta=25°C)	—	300	—	ms
Decay Time (Ta=25°C)	—	300	—	ms
Rise Time (Ta=0°C)	—	1000	—	ms
Decay Time (Ta=0°C)	—	1000	—	ms
Contrast Ratio	—	20:1	—	—
Viewing Angle	—	*	—	—
DC Resistance	—	10	—	MΩ
Expected Life	—	50000	—	Hours

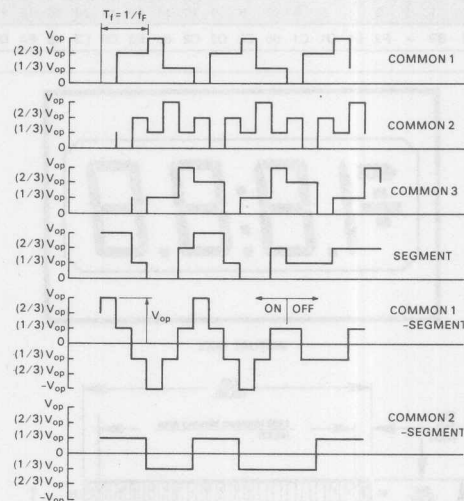
Environmental Test Specifications

Parameter	Min.	Typ.	Max.	Unit
Temperature/Humidity:				
A. No Polarizers				
80°C, 95% Relative Humidity		> 100		Hours
60°C, 70% Relative Humidity		> 500		Hours
B. Polarizers Attached				
60°C, 70% Relative Humidity		> 240		Hours
40°C, 95% Relative Humidity		> 500		Hours
Thermal Shock (No Polarizers):				
Liquid to Liquid				
2 Minutes @ 0°C, 2 minutes @ +80°C and a transfer time from one extreme to the other not to exceed 15 seconds.		5		Cycles
Temperature Cycling (Air to Air):				
Air to Air				
20 minutes @ -20°C to 20 minutes @ +60°C and a transfer time from one extreme to the other not to exceed 10 minutes.		10		Cycles

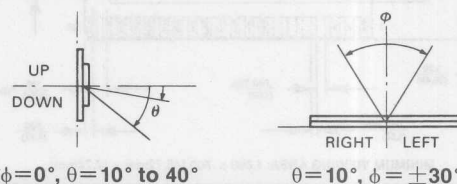
Mechanical Specifications

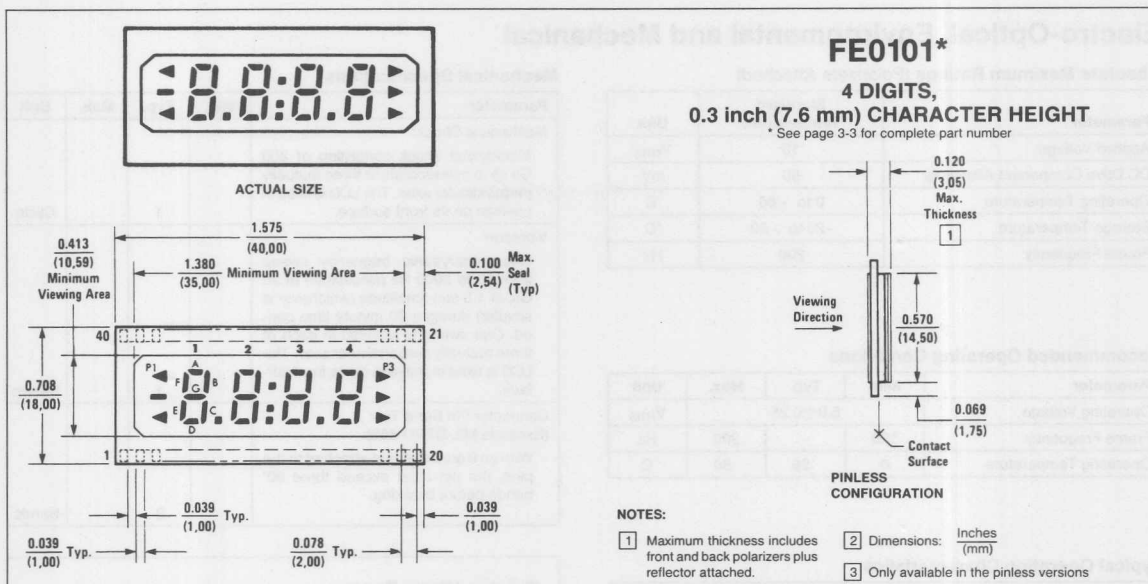
Parameter	Min.	Typ.	Max.	Unit
Mechanical Shock:				
Mechanical shock consisting of 300 Gs @ .5 milliseconds in three mutually perpendicular axes. The LCD is fixed in position on its front surface.		1		Cycle
Vibration				
One Logarithmic frequency sweep from 10 to 2000 Hz (sinusoidal) at 20 Gs, or 1.5 mm amplitude (whichever is smaller) during a 20 minute time period. One sweep is required in each of three mutually perpendicular axes. The LCD is fixed in position on its front surface.		1		Sweep
Connector Pin Bend Test (Exceeds MIL-STD-883):				
With an 8 ounce weight attached to the pins, the pin must exceed three 90° bends before breaking.		3		Bends

Driving Wave Form

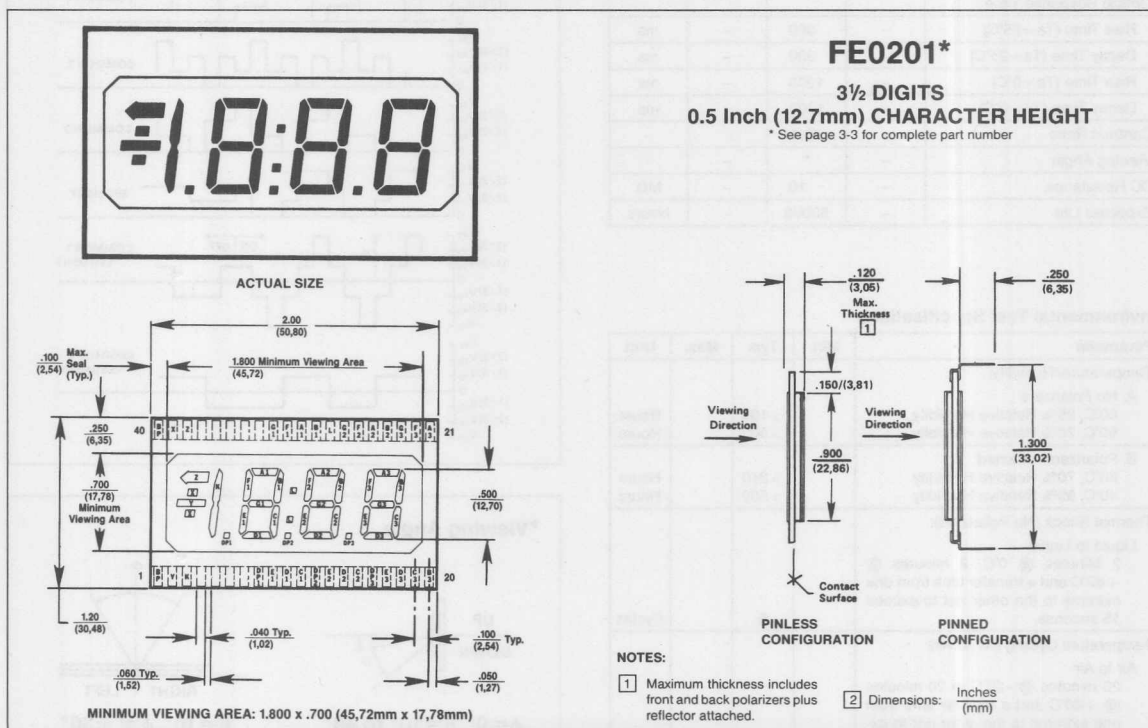


*Viewing Angle

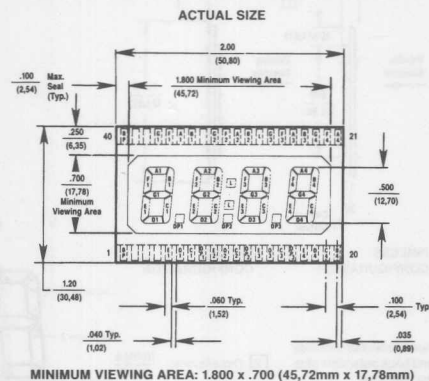




Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Segment	BP	-	P2	E1	D1	C1	dp	E2	D2	C2	dp	E3	D3	C3	dp	E4	D4	C4	P5	P4	P3	B4	A4	F4	G4	B3	A3	F3	G3	COL	B2	A2	F2	G2	B1	A1	F1	G1	P1	BP



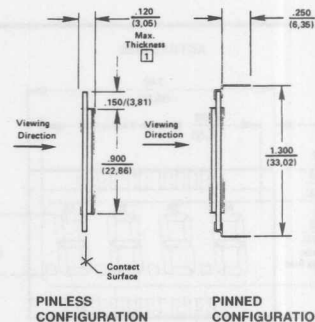
Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	
Segment	BP	Y	K	N/C	N/C	N/C	N/C	dp1	E1	D1	C1	dp2	E2	D2	C2	dp3	E3	D3	C3	B3	A3	F3	G3	B2	A2	F2	G2	L	B1	A1	F1	G1	N/C	N/C	N/C	N/C	N/C	N/C	Z	X	BP



FE0202*

4 DIGITS,
0.5 inch (12.7 mm) CHARACTER HEIGHT

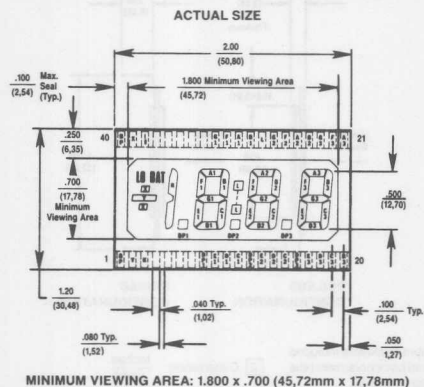
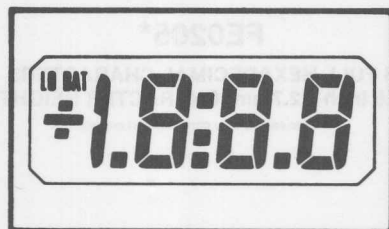
* See page 3-3 for complete part number



NOTES:

- 1 Maximum thickness includes front and back polarizers plus reflector attached.
- 2 Dimensions: Inches (mm)

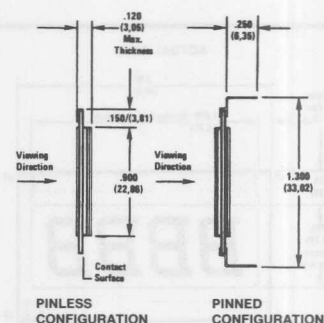
Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Segment	BP	N/C	N/C	N/C	E1	D1	C1	dp1	E2	D2	C2	dp2	E3	D3	C3	dp3	E4	D4	C4	B4	A4	F4	G4	B3	A3	F3	G3	L	B2	A2	F2	G2	N/C	B1	A1	F1	G1	N/C	N/C	BP



FE0203*

3½ DIGITS
0.5 Inch (12.7mm) CHARACTER HEIGHT

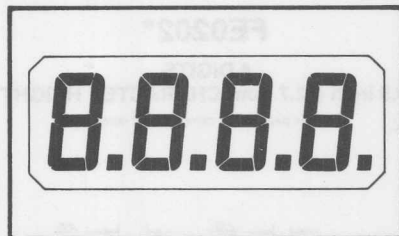
* See page 3-3 for complete part number



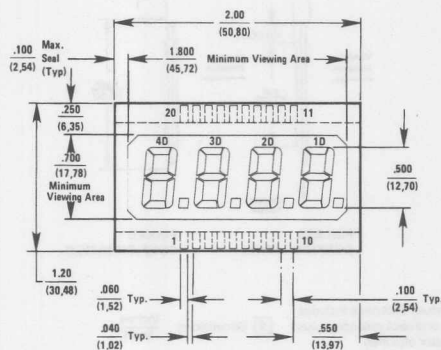
NOTES:

- 1 Maximum thickness includes front and back polarizers plus reflector attached.
- 2 Dimensions: Inches (mm)

Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Segment	BP	Y	K	N/C	N/C	N/C	N/C	dp1	E1	D1	C1	dp2	E2	D2	C2	dp3	E3	D3	C3	B3	A3	F3	G3	B2	A2	F2	G2	L	B1	A1	F1	G1	N/C	N/C	N/C	N/C	N/C	LO	X	BP



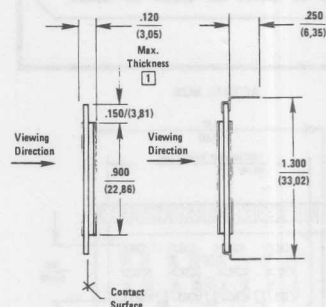
ACTUAL SIZE



FE0204M*

4 DIGITS,
0.5 inch (12.7 mm) CHARACTER HEIGHT

* See page 3-3 for complete part number



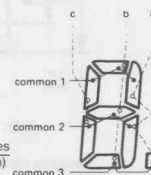
PINLESS
CONFIGURATION

PINNED
CONFIGURATION

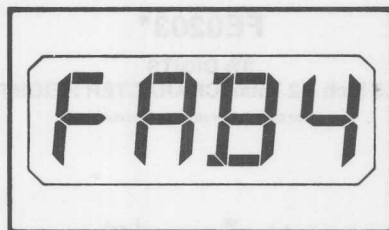
NOTES:

1 Maximum thickness includes front and back polarizers plus reflector attached.

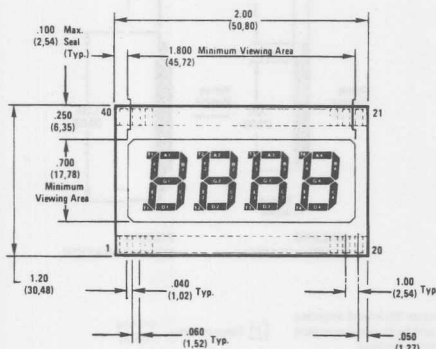
2 Dimensions: Inches (mm)



Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Segment	NC	NC	NC	4D-a	3D-a	2D-a	1D-a	BP3	NC	NC	BP1	1D-b	1D-c	2D-b	2D-c	3D-b	3D-c	4D-b	4D-c	BP2



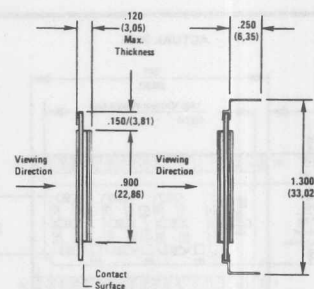
ACTUAL SIZE



FE0205*

4 FULL HEXADECIMAL CHARACTERS
0.5 inch (12.7mm) CHARACTER HEIGHT

* See page 3-3 for complete part number



PINLESS
CONFIGURATION

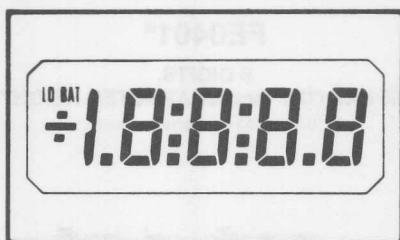
PINNED
CONFIGURATION

NOTES:

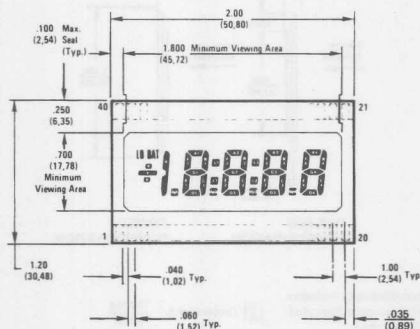
1 Maximum thickness includes front and back polarizers plus reflector attached.

2 Dimensions: Inches (mm)

Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Segment	BP	T1	E1	D1	C1	T2	E2	D2	C2	N/C	T3	E3	D3	C3	T4	E4	D4	C4	N/C	N/C	N/C	G4	B4	A4	F4	G3	B3	A3	F3	N/C	G2	B2	A2	F2	G1	B1	A1	F1	N/C	BP



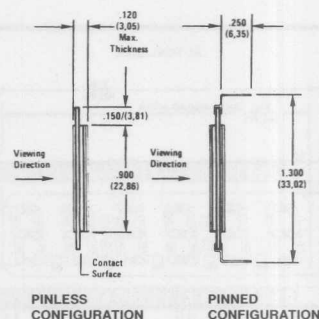
ACTUAL SIZE



FE0206*

4 1/2 DIGITS,
0.4 inch (10.2 mm) CHARACTER HEIGHT

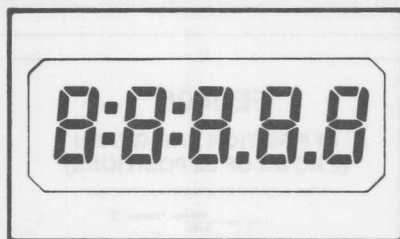
* See page 3-3 for complete part number



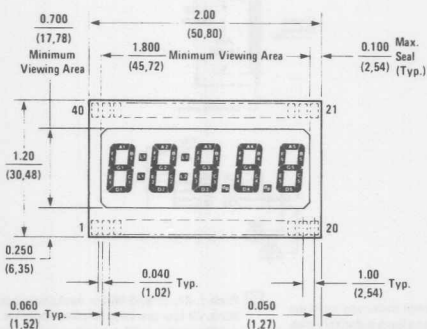
NOTES:

- 1 Maximum thickness includes front and back polarizers plus reflector attached.
- 2 Dimensions: Inches (mm)

Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Segment	BP	Y	K	DP1	E1	D1	C1	DP2	E2	D2	C2	DP3	E3	D3	C3	DP4	E4	D4	C4	B4	A4	F4	G4	B3	A3	F3	G3	L2	B2	A2	F2	G2	L1	B1	A1	F1	G1	BAT	X	BP



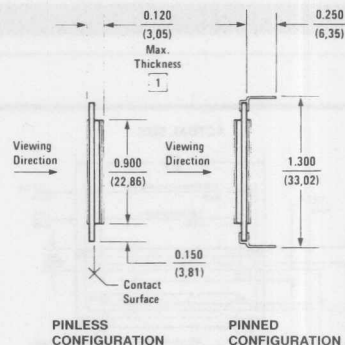
ACTUAL SIZE



FE0208*

5 DIGITS
0.4 Inch (10.2mm) CHARACTER HEIGHT

* See page 3-3 for complete part number



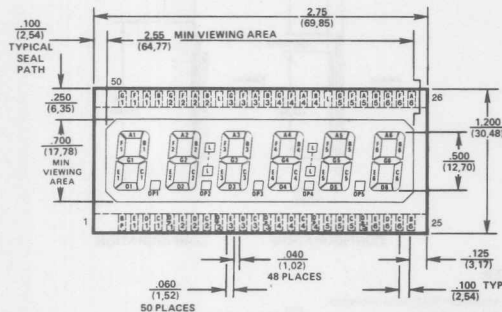
NOTES:

- 1 Maximum thickness includes front and back polarizers plus reflector attached.
- 2 Dimensions: Inches (mm)

Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Segment	BP	G1	E1	D1	C1	E2	D2	C2	E3	D3	C3	DP1	E4	D4	C4	DP2	E5	D5	C5	B5	A5	F5	G5	B4	A4	F4	G4	B3	A3	F3	G3	L2	B2	A2	F2	G2	L1	B1	A1	F1

8.8:8.8:8.8

ACTUAL SIZE

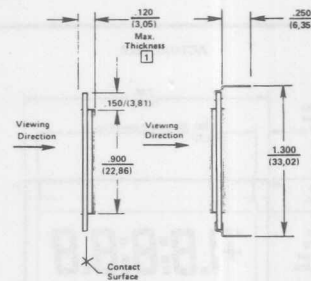


MINIMUM VIEWING AREA: 2.550 x .700 (64,77mm x 17,78mm)

FE0401*

6 DIGITS,
0.5 inch (12.7 mm) CHARACTER HEIGHT

* See page 3-3 for complete part number



PINLESS CONFIGURATION

PINNED CONFIGURATION

NOTES:

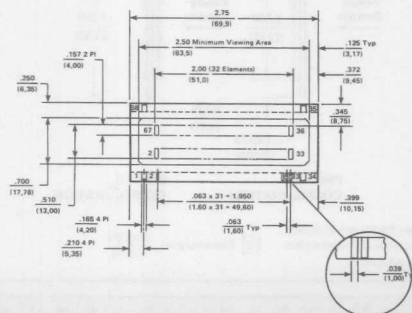
- 1 Maximum thickness includes front and back polarizers plus reflector attached.
- 2 Dimensions: Inches (mm)

Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Segment	BP	E1	D1	C1	dp1	E2	D2	C2	dp2	E3	D3	C3	dp3	E4	D4	C4	dp4	E5	D5	C5	dp5	E6	D6	C6	B6	A6	F6	G6	B5	A5	F5	G5	L	B4	A4	F4	G4	B3	A3	F3

Pin. No.	41	42	43	44	45	46	47	48	49	50
Segment	G3	L	B2	A2	F2	G2	B1	A1	F1	G1

THOUGH EXTENDING (min. 0.1 inch) 3.3

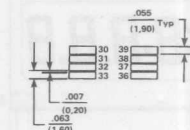
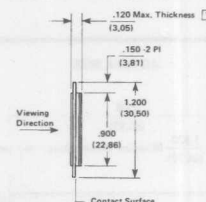
ACTUAL SIZE



FE0405*

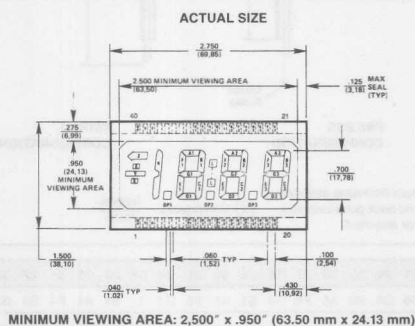
64 POSITION BAR GRAPH
(2 ROWS OF 32 POSITIONS)

* See page 3-3 for complete part number



NOTES:

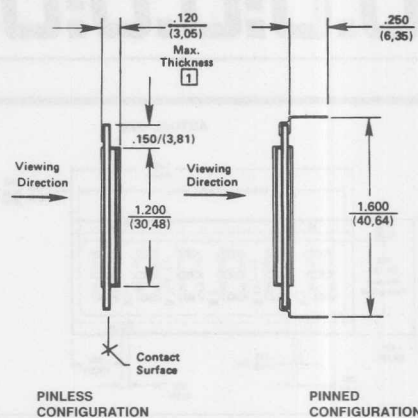
- 1 Maximum thickness includes front and back polarizers plus reflector attached.
- 2 Dimensions: Inches (mm)
- 3 Pads 1, 34, 35 and 68 are backplane connections. All four are internally tied together. One or all may be used if it is recommended to use at least two.
- 4 Display orientation is not critical (no specific left of right side).
- 5 Only available in pinless versions.



FE0501*

3 1/2 DIGITS,
0.7 inch (17.8 mm) CHARACTER HEIGHT

* See page 3-3 for complete part number

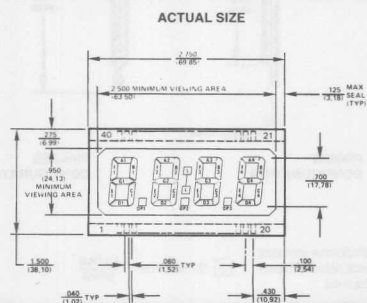
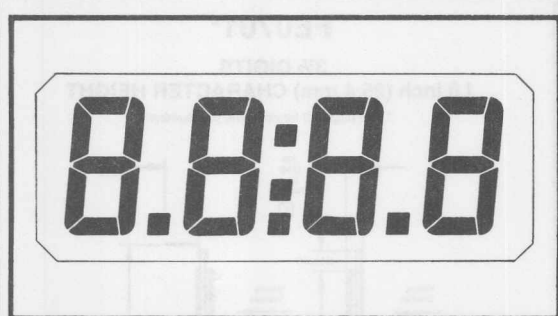


NOTES:

- 1 Maximum thickness includes front and back polarizers plus reflector attached.
- 2 Dimensions: Inches (mm)

Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	
Segment	BP	Y	K	N/C	N/C	N/C	N/C	dp1	E1	D1	C1	dp2	E2	D2	C2	dp3	E3	D3	C3	B3	A3	F3	G3	B2	A2	F2	G2	L	B1	A1	F1	G1	N/C	N/C	N/C	N/C	N/C	N/C	Z	X	BP

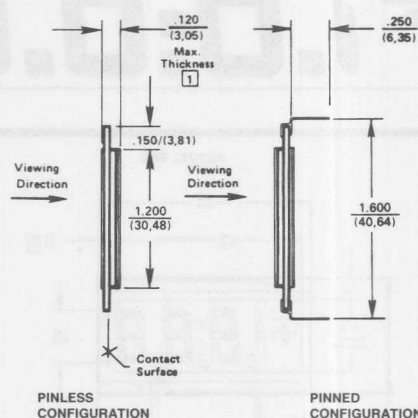
3



FE0502*

4 DIGITS,
0.7 inch (17.8 mm) CHARACTER HEIGHT

* See page 3-3 for complete part number



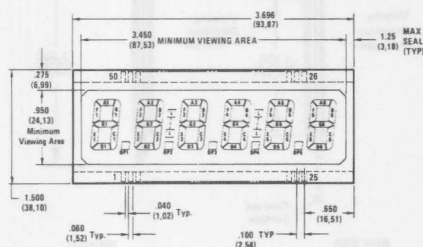
NOTES:

- 1 Maximum thickness includes front and back polarizers plus reflector attached.
- 2 Dimensions: Inches (mm)

Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Segment	BP	N/C	N/C	N/C	E1	D1	C1	dp1	E2	D2	C2	dp2	E3	D3	C3	dp3	E4	D4	C4	B4	A4	F4	G4	B3	A3	F3	G3	L	B2	A2	F2	G2	N/C	B1	A1	F1	G1	N/C	N/C	BP

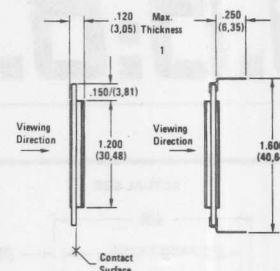


ACTUAL SIZE



FE0601* **6 DIGITS,** **0.7 inch (17.8 mm) CHARACTER HEIGHT**

* See page 3-3 for complete part number



PINLESS CONFIGURATION

PINNED CONFIGURATION

NOTES:

1 Maximum thickness includes front and back polarizers plus reflector attached.

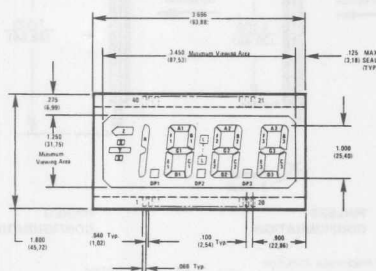
2 Dimensions: Inches (mm)

Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Segment	BP	E1	D1	C1	dp1	E2	D2	C2	dp2	E3	D3	C3	dp3	E4	D4	C4	dp4	E5	D5	C5	dp5	E6	D6	C6	B6	A6	F6	G6	B5	A5	F5	G5	L	B4	A4	F4	G4	B3	A3	F3

Pin. No.	41	42	43	44	45	46	47	48	49	50
Segment	G3	L	B2	A2	F2	G2	B1	A1	F1	G1

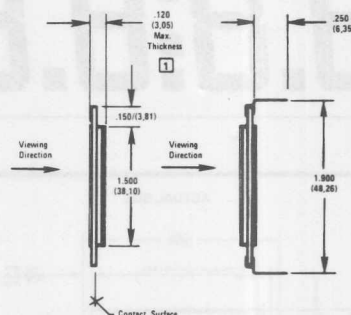


ACTUAL SIZE



FE0701* **3 1/2 DIGITS,** **1.0 inch (25.4 mm) CHARACTER HEIGHT**

* See page 3-3 for complete part number



PINNED CONFIGURATION

PINLESS CONFIGURATION

NOTES:

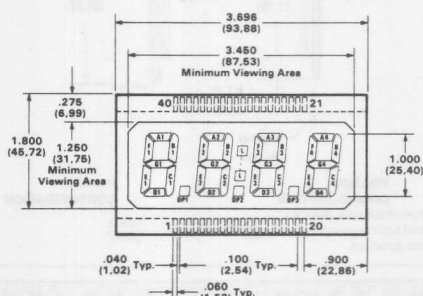
1 Maximum thickness includes front and back polarizers plus reflector attached.

2 Dimensions: Inches (mm)

Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	
Segment	BP	Y	K	N/C	N/C	N/C	N/C	dp1	E1	D1	C1	dp2	E2	D2	C2	dp3	E3	D3	C3	B3	A3	F3	G3	B2	A2	F2	G2	L	B1	A1	F1	G1	N/C	N/C	N/C	N/C	N/C	N/C	Z	Y	BP



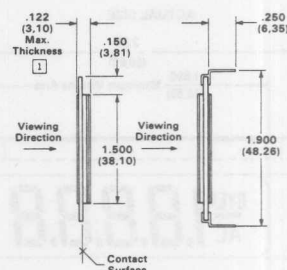
ACTUAL SIZE



FE0703*

4 DIGITS,
1.0 inch (25.4 mm) CHARACTER HEIGHT

* See page 3-3 for complete part number



PINLESS
CONFIGURATION

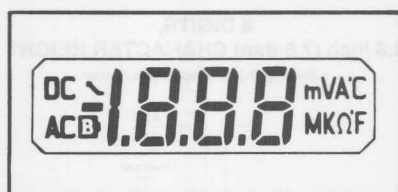
PINNED
CONFIGURATION

NOTES:

- Glass thickness (non-accumulative) is .043 (1.1) \pm .006 (.15). Total thickness of bare cell (front and rear glass) is .087 (2.2) \pm .008 (.2).
- Dimensions: Inches (mm)

Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Segment	BP	N/C	N/C	N/C	E1	D1	C1	dp1	E2	D2	C2	dp2	E3	D3	C3	dp3	E4	D4	C4	B4	A4	F4	G4	B3	A3	F3	G3	L	B2	A2	F2	G2	N/C	B1	A1	F1	G1	N/C	N/C	BP

3



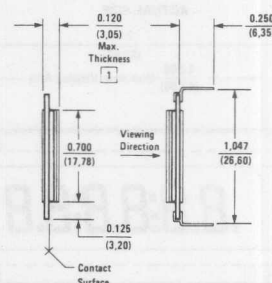
ACTUAL SIZE



FE0801*

3½ DIGITS,
0.4 inch (10.2 mm) CHARACTER HEIGHT

* See page 3-3 for complete part number



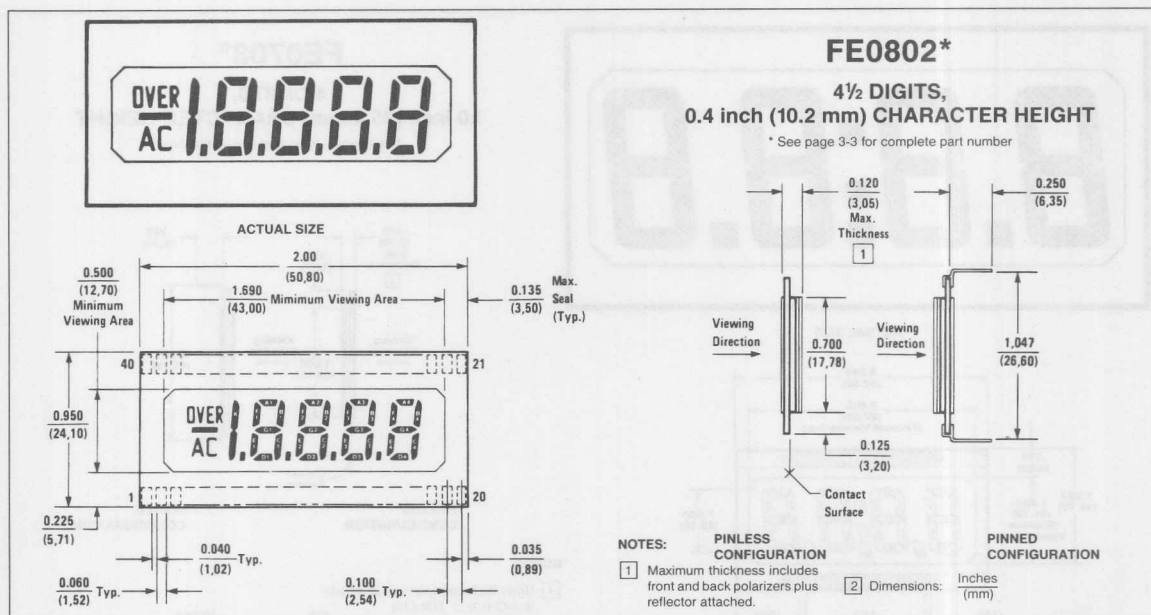
PINLESS
CONFIGURATION

PINNED
CONFIGURATION

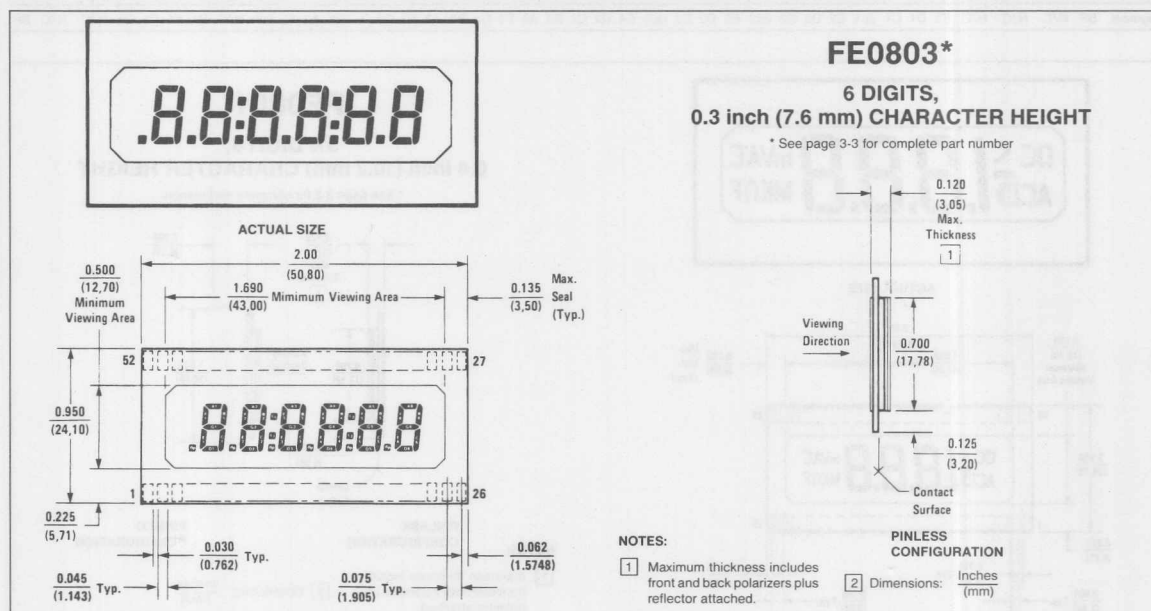
NOTES:

- Maximum thickness includes front and back polarizers plus reflector attached.
- Dimensions: Inches (mm)

Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Segment	BP	N/C	AC	BAT	K	dp	E1	D1	C1	dp	E2	D2	C2	dp	E3	D3	C3	M	K	Ω	°F	°C	A	V	m	B3	A3	F3	G3	B2	A2	F2	G2	B1	A1	F1	G1	OV	-	DC

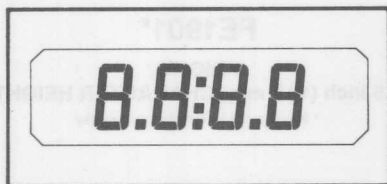


Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Segment	BP	N/C	AC	K	dp	E1	D1	C1	dp	E2	D2	C2	dp	E3	D3	C3	dp	E4	D4	C4	B4	A4	F4	G4	B3	A3	F3	G3	B2	A2	F2	G2	B1	A1	F1	G1	N/C	OV	-	N/C



Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Segment	BP	dp	E1	D1	C1	dp	E2	D2	C2	dp	E3	D3	C3	dp	E4	D4	C4	dp	E5	D5	C5	dp	E6	D6	C6	B6	A6	F6	G6	B5	A5	F5	G5	L2	B4	A4	F4	G4	B3	A3

Pin. No.	41	42	43	44	45	46	47	48	49	50	51	52
Segment	F3	G3	L1	B2	A2	F2	G2	B1	A1	F1	G1	BP

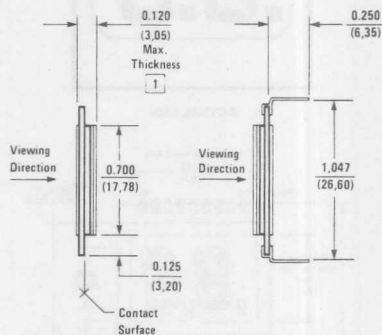


ACTUAL SIZE



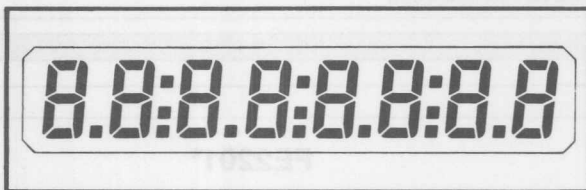
FE0804* 4 DIGITS, 0.35 inch (8.9 mm) CHARACTER HEIGHT

* See page 3-3 for complete part number



- NOTES:**
- 1 Maximum thickness includes front and back polarizers plus reflector attached.
 - 2 Dimensions: Inches (mm)

Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Segment	BP	N/C	N/C	N/C	E1	D1	C1	DP1	E2	D2	C2	DP2	E3	D3	C3	DP3	E4	D4	C4	B4	A4	F4	G4	B3	A3	F3	G3	COL	B2	A2	F2	G2	N/C	B1	A1	F1	G1	N/C	N/C	BP

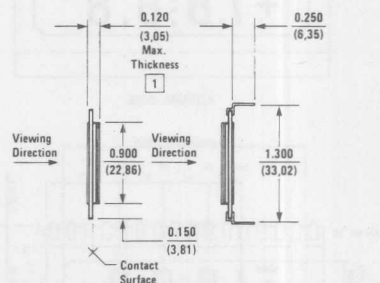


ACTUAL SIZE



FE1001* 8 DIGITS, 0.5 inch (12.7 mm) CHARACTER HEIGHT

* See page 3-3 for complete part number



- NOTES:**
- 1 Maximum thickness includes front and back polarizers plus reflector attached.
 - 2 Dimensions: Inches (mm)

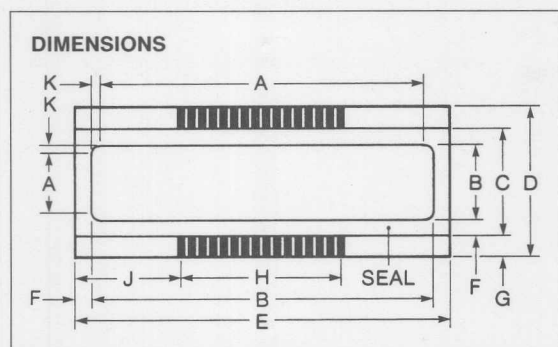
Pin. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Segment	BP	E1	D1	C1	dp	E2	D2	C2	dp	BP	E3	D3	C3	dp	E4	D4	C4	dp	E5	D5	C5	dp	E6	D6	C6	dp	E7	D7	C7	dp	E8	D8	C8	B8	A8	F8	G8	B7	A7	F7

Pin. No.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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Segment	BP	DP1	E1	D1	C1	DP2	E2	D2	C2	B2	A2	F2	G2	B1	A1	F1	G1	BP
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Please complete this form in its entirety. For the artwork, attach your drawings or sketch in the space provided below.



- A. Image Area _____ x _____
B. Viewing Area _____ x _____
C. Minor Glass _____
D. Major Glass _____
E. Minor, Major Glass _____
F. Seal Width, (.100" min.) _____ x _____
G. Contact Area (.100" min.) _____
H. Center Line of End Contacts _____
J. Contact Registration _____
K. Image to Seal Clearance (.050" min.) _____ x _____

OPERATING SPECIFICATIONS

Driving Method: ☐ Direct Drive
☐ Multiplex _____ Duty, _____ Bias
Operating Frequency: _____ Hz
Operating Temperature: _____ to _____ °C
Temperature/Humidity: _____ °C _____ % R.H. _____ Hours
Driver Type: _____ DC Voltage _____

POLARIZERS

Polarizer Grade: ☐ Commercial ☐ High Stability
Mode: ☐ 1-Reflective ☐ 2-Transmissive
☐ 3-Transflective

VIEWING ANGLE

☐ 6:00 ☐ 12:00

CONNECTOR

☐ Zebra Strip ☐ Pinned Pin Length _____

ESTIMATED ANNUAL USAGE (1000 Min.) _____

INITIAL ORDER

VOLUME REQUIRED _____

WHEN TO BE PLACED? _____

DISPLAY DRAWINGS

COMPANY NAME _____

ADDRESS _____

CITY _____

STATE _____

ZIP CODE _____

NAME _____

TITLE _____

PHONE _____

SEND THE INFORMATION BY FAX OR BY LETTER TO:

FAX NO. 415 340-1670

ADDRESS: AND
770 AIRPORT BLVD.
BURLINGAME, CA 94010

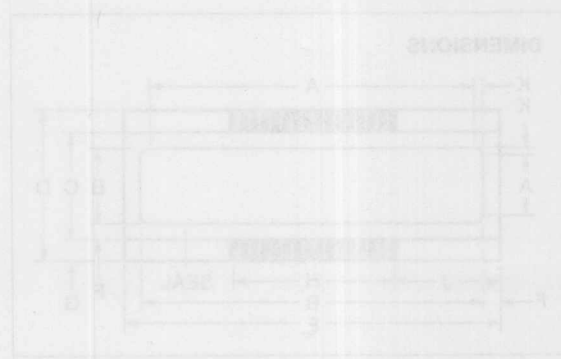


Order 1-800-451-1111

ORDERLINE

Please complete this form and return it to the address below. Do not include this form in the shipping container.

DISPLAY DRAWING



- A. Image Area
- B. Viewing Area
- C. Mirror Glass
- D. Mirror Glass
- E. Mirror Glass Glass
- F. Seal Width (100 mil)
- G. Contact Area (100 mil)
- H. Contact Area of End Contacts
- I. Contact Resistance
- J. Image to First Channel (100 mil)

OPERATING SPECIFICATIONS

Diving Method ☐ Diving Dive
☐ Multiple
 Operating Pressure _____
 Operating Temperature _____
 Temperature Stability _____
 Drive Type _____
 DC Voltage _____

POLARIZERS

Polarizer Grade ☐ Commercial ☐ High Quality
 Mode ☐ Transmissive ☐ Reflective
☐ 2-Transmitted

VIEWING ANGLE

☐ 60° ☐ 150°

CONNECTION

☐ Cable Grip ☐ Pinout ☐ Pin Lug

ESTIMATED ANNUAL USAGE (1000 min)

INITIAL ORDER

VOLUME REQUIRED _____

WHEN TO BE PLACED _____

SEND THE INFORMATION BY FAX OR BY LETTER TO:

FAX NO. 415 950-1570

ADDRESS: AND
 170 AIRPORT BLVD.
 BURLINGAME, CA 94010

4-1



Type No.	Number of Characters/Dots	Character/Dot Size (mm)	Viewing Area (mm)	Outline Dimension (mm)	Driving Voltage (V)	Controller	—30	—EO	Page No.
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Character Displays with Controller/RAM

AND241	16 x 1	3.15 W x 7.9 H	64.5 W x 13.8 H	80 W x 36 H x 12 D	+5	HD44780 or equivalent	—	—	4-4
AND671	16 x 1	3.15 W x 5.76 H	64.5 W x 13.8 H	80 W x 36 H x 12 D	+5		Yes	—	4-6
AND691	24 x 1	3.2 W x 7.95 H	100 W x 13.8 H	126 W x 36 H x 12 D	+5		Yes	—	4-10
AND601	40 x 1	3.2 W x 7.95 H	154.8 W x 17.5 H	182 W x 33.5 H x 13 D	+5		Yes	—	4-12
AND491	16 x 2	2.95 W x 4.29 H	64.5 W x 15 H	80 W x 36 H x 12 D	+5		Yes	—	4-14
AND501	20 x 2	3.21 W x 5.55 H	83 W x 18.6 H	116 W x 37 H x 12.5 D	+5		Yes	—	4-18
AND501-EO	20 x 2	3.21 W x 5.55 H	83 W x 18.6 H	116 W x 37 H x 12.5 D	+5		—	Yes	—
AND771	24 x 2	3.21 W x 5.07 H	93.5 W x 16.5 H	118 W x 36 H x 12 D	+5		Yes	—	4-20
AND771-EO	24 x 2	3.21 W x 5.07 H	93.5 W x 16.5 H	118 W x 36 H x 12 D	+5		—	Yes	—
AND591	40 x 2	3.2 W x 5.55 H	154.8 W x 17.5 H	182 W x 33.5 H x 13 D	+5		Yes	—	4-22
AND591-EO	40 x 2	3.2 W x 5.55 H	154.8 W x 17.5 H	182 W x 33.5 H x 13 D	+5		—	Yes	—
AND731	16 x 4	2.96 W x 4.51 H	61.8 W x 26.6 H	87 W x 60 H x 12 D	+5		Yes	—	4-24
AND721	20 x 4	2.96 W x 4.51 H	76 W x 27 H	98 W x 60 H x 12 D	+5		Yes	—	4-26
AND721-EO	20 x 4	2.96 W x 4.51 H	76 W x 27 H	98 W x 60 H x 12 D	+5		—	Yes	—
AND1001	40 x 4	3.95 W x 5.55 H	199 W x 44 H	221 W x 76 H x 12.5 D	+/-5	T6963C	—	—	4-28

LED Backlight Character Displays with Controller/RAM

AND493-JO	16 x 2	2.95 W x 4.29 H	64.5 W x 15 H	80 W x 36 H x 16 D	+5	HD44780	LED		4-16
AND673-JO	16 x 1	3.15 W x 5.76 H	64.5 W x 13.8 H	80 W x 36 H x 16 D	+5	HD44780	LED		4-8

Graphic Displays with Controller/RAM

AND1021	120 W x 64 H	0.44 W x 0.56 H	62.5 W x 43.5 H	85 W x 70 H x 20 D	+5/-8.5	T6963C	Yes	Yes	4-30
AND711A	240 W x 64 H	0.49 W x 0.49 H	132 W x 39 H	180 W x 65 H x 12 D	+5/-8.5	T6963C	Yes	Yes	4-38

Graphic Displays with Super Twist Nematic with Controller

AND711AST	240 W x 64 H	0.49 W x 0.49 H	132 W x 39 H	180 W x 65 H x 12 D	+5/-8.5	T6963C	Yes	—	4-40
AND1021ST	120 W x 64 H	0.44 W x 0.56 H	62.5 W x 43.5 H	85 W x 70 H x 20 D	+5/-8.5	T6963C	Yes	—	4-32
AND1013ST	160 W x 128 H	0.56 W x 0.56 H	101 W x 82 H	129 W x 104.5 H x 14 D	+5/-8.5	T6963C	Yes	—	4-36
AND1301VST	240 W x 128 H	0.66 W x 0.66 H	179.9 W x 101.5 H	240 W x 125.3 H x 12 D	+5/-14.5	T6963C	Yes	—	4-42
AND1391ST	128 W x 128 H	0.40 W x 0.40 H	62.0 W x 62.0 H	85 W x 100 H x 14 D	+5/-14.5	T6963C	Yes	—	4-34
AND1741MST	240 W x 128 H	0.47 W x 0.47 H	126.0 W x 70.0 H	170 W x 106 H x 14 D	—	T6963C	CCFL		4-44
AND711AST-EO	240 W x 64 H	0.49 W x 0.49 H	132 W x 39 H	180 W x 65 H x 12 D	+5/-8.5	T6963C	—	Yes	—
AND1021ST-EO	120 W x 64 H	0.44 W x 0.56 H	62.5 W x 43.5 H	85 W x 70 H x 20 D	+5/-8.5	T6963C	—	Yes	—
AND1013ST-EO	160 W x 128 H	0.56 W x 0.56 H	101 W x 82 H	129 W x 104.5 H x 14 D	+5/-8.5	T6963C	—	Yes	—
AND1301VST-EO	240 W x 128 H	0.66 W x 0.66 H	179.9 W x 101.5 H	240 W x 125.3 H x 12 D	+5/-14.5	T6963C	—	Yes	—
AND1391ST-EO	128 W x 128 H	0.40 W x 0.40 H	62.0 W x 62.0 H	85 W x 100 H x 14 D	+5/-14.5	T6963C	—	Yes	—

Graphic Displays with Super Twist Nematic without Controller

AND1241ST	480 W x 128 H	0.48 W x 0.48 H	236 W x 67 H	277 W x 83 H x 14 D	+5/-14.5	(T7779)	Yes	—	4-47
AND932ST	640 W x 200 H	0.345 W x 0.345 H	249 W x 82 H	293 W x 97.6 H x 14 D	+5/-22.5	(T7779)	—	—	4-50
AND561ST	640 W x 200 H	0.32 W x 0.46 H	231 W x 105 H	275 W x 126 H x 14 D	+5/-22.5	(T7779)	Yes	Yes	4-53
AND1342BST	640 W x 200 H	0.32 W x 0.46 H	231 W x 105 H	275 W x 126 H x 14 D	+5/-22.5	(T7779)	—	Yes	4-54
AND1181ST	640 W x 400 H	0.32 W x 0.32 H	230 W x 146 H	276 W x 186 H x 14 D	+5/-22.5	(T7779)	Yes	Yes	4-57
AND1181BST	640 W x 400 H	0.32 W x 0.32 H	230 W x 146 H	276 W x 186 H x 14 D	+5/-22.5	(T7779)	—	Yes	4-58
AND1501MST	640 W x 400 H	0.30 W x 0.30 H	217 W x 138 H	320 W x 197.4 H x 22 D	+5/-15.7	(T7779)	CCFL		4-61
AND1551MST	640 W x 480 H	0.28 W x 0.28 H	206 W x 156 H	276 W x 182 H x 20 D	+5/-24.0	(T7779)	CCFL		—

- 1) Standard AND LCD modules are configured to operate in a reflective viewing mode. Transflective and transflective viewing modes with electroluminescent lamps installed are also available for most modules.
- 2) **-30** suffix designates a module with a transflective backing rather than a reflective one (i.e. AND591-30 for a transflective 40 character x 2 line dot matrix LCD module). The transflective backing makes viewing possible under normal ambient light or by using a backlight. The backlight slips between the LCD and the PC board making viewing possible in dark or dim lighting conditions.
- 3) **-EO** suffix designates a module which has a transflective backing and an electroluminescent lamp (EL) installed (i.e. AND591-EO for 40 character x 2 line dot matrix LCD module with EL lamp). Normally an inverter is necessary to generate the high frequency AC signal needed by the EL lamp. The backlight operates on 110 VAC at 500 Hz.
- 4) **LED** Backlit modules have a transflective backing and LED backlight array installed. The backlight operates on 4.1 V and a maximum current of 220 mA.
- 5) Cold Cathode Fluorescent Lamp (CCFL) backlighting is available for certain modules.
- 6) Application and software command information is located under character LCD module interface data and medium size graphic LCD interface application notes.

The new AND SUPER TWIST LCD Modules, with high contrast ratios, wide viewing angles, and improved legibility, meet the growing demand for clear, readable, large LCD displays.

AND has developed the ST LCD Modules combining the latest liquid crystal materials, up to date production process, and newest circuit technology. AND offers various modules for office automation equipment, factory automation equipment, home automation equipment, as well as many other applications.

AND ST LCD Module

FEATURES

- Excellent readability from the viewing angle normal to the LCD panel.
- High contrast and wide viewing angle.
- Clear and easy-to-read display with achromatic background (W-ST).
- Sharp and clear display with EL backlight (B-ST).
- Fast response time.
- High display quality with uniform background.

Differences Between TN and ST LCD

By using the birefringence characteristics of the liquid crystal module, the new ST LCD module obtains a wide viewing angle and high contrast.

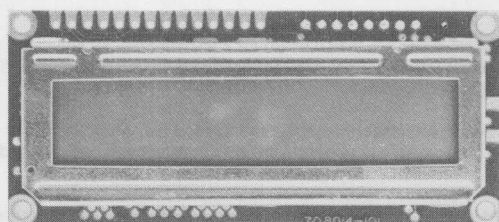
Sharp voltage/contrast characteristics make it possible for a high multiplexing drive up to 1/200 duty.

AND ST LCD Module Product Applications

ST LCD Modules can be applied for the various products, such as; portable computers, work stations, word processors, electronic typewriters, copiers, facsimile equipments, hand-held computers, handy terminals, PBXs (private telephone exchanges), POS terminals and oscilloscopes.

■ Comparison of Characteristics in Various ST Mode LCDs (example using 1/200 duty ratio)

	W-ST Type	B-ST Type	M-ST Type	TN
Contrast	≧3.5	≧6.0	≧12.0	≧3.5
Viewing angle	-15 ~ 40° (optimum viewing direction: 0°)			10 ~ 40°
Response	≦200ms (room temperature)			≦200ms
Display color	Purple blue	Dark blue	Black	Black
Background color	Gray	White	White	Gray
Operating temperature	0 ~ 50°C			0 ~ 50°C
Storage temperature	-20 ~ 60°C			-20 ~ 70°C

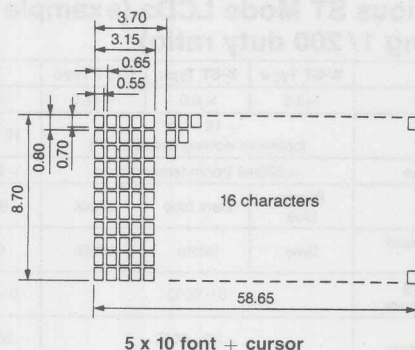


The AND241 is a compact LCD module having a dot matrix LCD panel, a controller and driver circuit. This module can display 160 kinds of letters, numerals, symbols and "Kana" letters, as well as 8 custom characters.

FEATURES

- Compact, integrated display module.
- High contrast, clear display with large characters.
- Low voltage, +5V single power supply.
- Wide operating temperature range (0°C to +50°C).
- 5 x 10 dot character format and cursor line.
- Built-in control LSI with display RAM and character generator ROM.
- Direct interface to 4 or 8 bit CPU.
- 11 commands for control.

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	80 W x 36 H x 12 D	mm
Character Size	3.15 W x 7.9 H	mm
Number of Characters	16 x 1 (16) Characters (5 x 10 font + cursor)	-
Viewing Area	64.5 W x 13.8 H	mm
Bezel Opening	64.5 W x 13.8 H	mm
Dot Size	0.55 W x 0.7 H	mm
Dot Pitch	0.65 W x 0.8 H	mm
Weight	approx. 25	gram

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	7	V
Input Voltage	V_{IN}	$0 \leq V_{IN} \leq V_{DD}$	V
Operating Temperature	T_{op}	0 to +50	°C
Storage Temperature	T_{stg}	-20 to +70	°C

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD}	4.75	5.0	5.25	V
	GND	-	0	-	
"H" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IH}	2.2	-	-	V
"L" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IL}	-	-	0.6	V
"H" Level Output Voltage ($I_{OH} = 0.2\text{mA}$)	V_{OH}	2.4	-	-	V
"L" Level Output Voltage ($I_{OL} = 1.2\text{mA}$)	V_{OL}	-	-	0.4	V
Power Consumption	P_O	-	4.0	-	mW

Optical Characteristics ($T_A = 25^\circ\text{C}$, $\phi = 25^\circ$, $\theta = 0^\circ$)

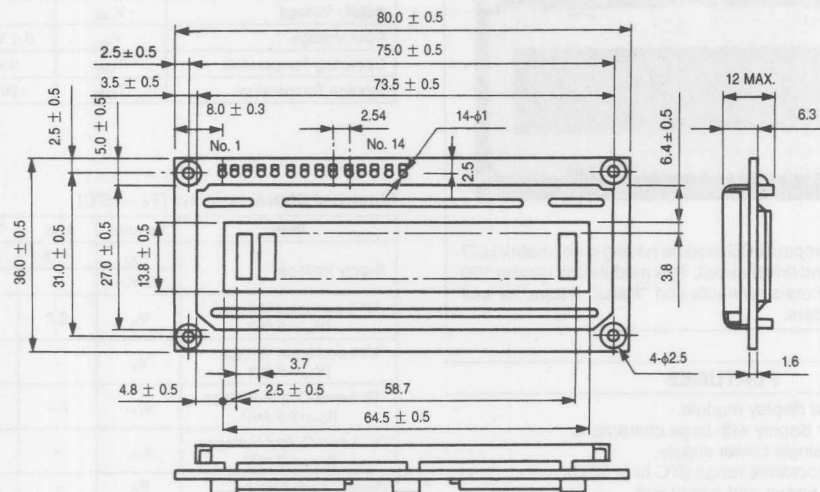
Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	ϕ	10	25	40	degree
Contrast	K	-	3.0	-	-
Turn On Time	t_{on}	-	200	400	ms
Turn Off Time	t_{off}	-	250	400	ms

Note: Refer to Applications Section for the following definitions: (a) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

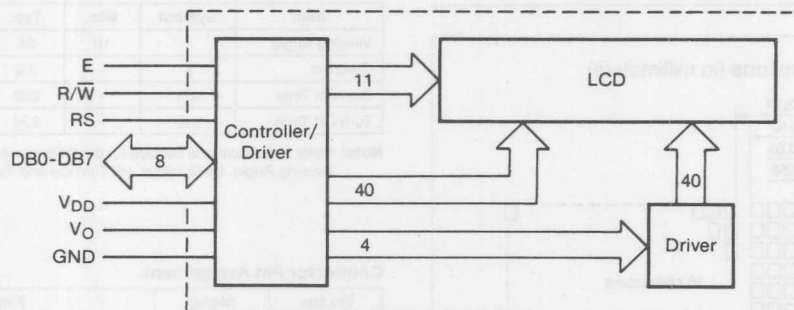
Connector Pin Assignment

Pin No.	Signal	Function	
1	GND	OV	Power Supply
2	V _{DD}	5V	
3	V _O	LCD Drive Voltage (OV to V _{DD})	
4	RS	"H" Data Input "L" Command Input	
5	R/W	"H" Data Read (Module → CPU) "L" Data Write (CPU → Module)	
6	E	Enable Signal	
7	DB0	Data Bus } 8-bit Use } 4-bit Use }	
8	DB1		
9	DB2		
10	DB3		
11	DB4		
12	DB5		
13	DB6		
14	DB7		

Dimensional Outline (in millimeters)

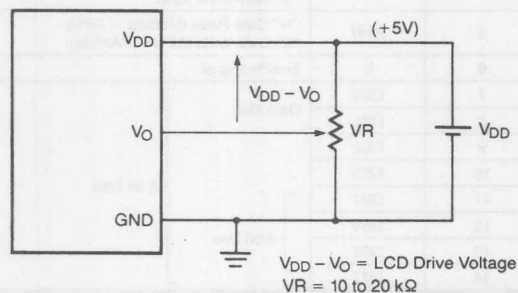


Block Diagram



4

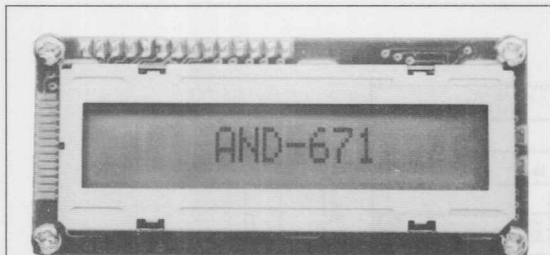
Power Supply



Recommended Power Supply for LCD Drive (V_O)

LCD Panel is driven by the voltage $V_{DD} - V_O$, so adjustable V_O is required for contrast control and temperature compensation.

Temperature	V_O
0°C	.3V
+25°C	.5V
+50°C	1.2V

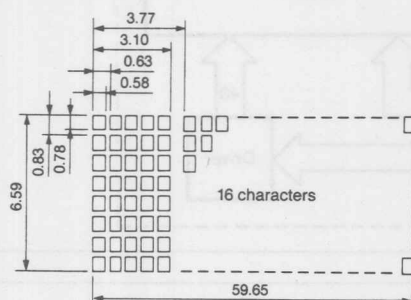


The AND671 is a compact LCD module having a dot matrix LCD panel, a controller and driver circuit. This module can display 160 kinds of letters, numerals, symbols and "Kana" letters, as well as 8 custom characters.

FEATURES

- Compact, integrated display module.
- High contrast, clear display with large characters.
- Low voltage, +5V single power supply.
- Wide operating temperature range (0°C to +50°C).
- 5 x 7 dot character format and cursor line.
- Built-in control LSI with display RAM and character generator ROM.
- Direct interface to 4 or 8 bit CPU.
- 11 commands for control.
- Transflective module is available as an option.

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	80 W x 36 H x 12 D	mm
Character Size	3.1 W x 5.76 H	mm
Number of Characters	16 x 1 (16) Characters (5 x 7 font + cursor)	-
Viewing Area	64.5 W x 13.8 H	mm
Bezel Opening	64.5 W x 13.8 H	mm
Dot Size	0.58 W x 0.78 H	mm
Dot Pitch	0.63 W x 0.83 H	mm
Weight	approx. 25	gram

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	7	V
Input Voltage	V_{IN}	$0 \leq V_{IN} \leq V_{DD}$	V
Operating Temperature	T_{OP}	0 to +50	°C
Storage Temperature	T_{STG}	-20 to +70	°C

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD}	4.75	5.0	5.25	V
	GND	-	0	-	
"H" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IH}	2.2	-	-	V
"L" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IL}	-	-	0.6	V
"H" Level Output Voltage ($I_{OH} = 0.2\text{mA}$)	V_{OH}	2.4	-	-	V
"L" Level Output Voltage ($I_{OL} = 1.2\text{mA}$)	V_{OL}	-	-	0.4	V
Power Consumption	P_O	-	5.0	-	mW

Optical Characteristics ($T_A = 25^\circ\text{C}$, $\phi = 25^\circ$, $\theta = 0^\circ$)

Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	ϕ	10	25	40	degree
Contrast	K	-	3.0	-	-
Turn On Time	t_{ON}	-	200	400	ms
Turn Off Time	t_{OFF}	-	250	400	ms

Note: Refer to Applications Section for the following definitions: (a) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

Connector Pin Assignment

Pin No.	Signal	Function
1	GND	Power Supply
2	V_{DD}	
3	V_O	LCD Drive Voltage (OV to V_{DD})
4	RS	"H" Data Input "L" Command Input
5	R/W	"H" Data Read (Module → CPU) "L" Data Write (CPU → Module)
6	E	Enable Signal
7	DB0	Data Bus 8-bit Use 4-bit Use
8	DB1	
9	DB2	
10	DB3	
11	DB4	
12	DB5	
13	DB6	
14	DB7	

[illegible]

The diagram illustrates the internal connections of the LCD module. On the left, external signals are connected to the Controller/Driver: E, R/W, RS, DB0-DB7 (8-bit bus), V_{DD}, V_O, and GND. The Controller/Driver is connected to the LCD via a 16-bit data bus and two 40-pin power lines. The LCD also has an 8-bit data bus connection to the Controller/Driver. The LCD is represented as a central block with a dashed line indicating its internal structure.

The diagram shows a voltage divider circuit. A 5V DC source is connected to a resistor V_R . The other end of V_R is connected to the V_{DD} pin of a device. The output voltage V_O is taken from the junction between the resistor and the V_{DD} pin. The voltage across the resistor is labeled $V_{DD} - V_O$. The device's ground is connected to the common ground of the circuit.

$V_{DD} - V_O = \text{LCD Drive Voltage}$
 $V_R = 10 \text{ to } 20 \text{ k}\Omega$

Recommended Power Supply for LCD Drive (V_O)
LCD Panel is driven by the voltage $V_{DD}-V_O$, so adjustable V_O is required for contrast control and temperature compensation.

Temperature	V _O
0°C	0.0V
+25°C	.5V
+50°C	1.0V

The AND673-JO is a compact LCD module having a dot matrix LCD panel, a controller and driver circuit. This module can display 160 kinds of letters, numerals, symbols and "Kana" letters, as well as 8 custom characters.

- LED backlight (yellow)
- Compact, integrated display module.
- High contrast, clear display with large characters.
- Low voltage, +5V single power supply.
- Wide operating temperature range (0°C to +50°C).
- 5 x 7 dot character format and cursor line.
- Built-in control LSI with display RAM and character generator ROM.
- Direct interface to 4 or 8 bit CPU.
- 11 commands for control.

Item	Specification	Unit
Outline Dimension	80 W x 36 H x 16 D	mm
Character Size	3.1 W x 5.76 H	mm
Number of Characters	16 x 1 (16) Characters (5 x 7 font + cursor)	-
Viewing Area	64.5 W x 13.8 H	mm
Bezel Opening	64.5 W x 13.8 H	mm
Dot Size	0.58 W x 0.78 H	mm
Dot Pitch	0.63 W x 0.83 H	mm
Weight	approx. 25	gram

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	7	V
Input Voltage	V_{IN}	$0 \leq V_{IN} \leq V_{DD}$	V
LED Forward Current	I_F	125	mA
LED Reverse Voltage	V_R	8	V
LED Power Dissipation	P_D	1000	mW
Operating Temperature	T_{op}	$0 \text{ to } +50$	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	$-20 \text{ to } +70$	$^{\circ}\text{C}$

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V _{DD}	4.75	5.0	5.25	V
	GND	–	0	–	
“H” Level Input Voltage (V _{DD} = 5.0V)	V _{IL}	2.2	–	–	V
“L” Level Input Voltage (V _{DD} = 5.0V)	V _{IL}	–	–	0.6	V
“H” Level Output Voltage (I _{OH} = 0.2 mA)	V _{OH}	2.4	–	–	V
“L” Level Output Voltage (I _{OL} = 1.2 mA)	V _{OL}	–	–	0.4	V
Power Consumption	P _O	–	5.0	–	mW
LED Forward Voltage (I _F = 110 mA)	V _F	3.8	4.0	4.2	V
LED Reverse Current (V _R = 8V)	I _R	–	–	1.1	mA

Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	ϕ	10	25	40	degree
Contrast	K	—	3.0	—	—
Turn On Time	ton	—	200	400	ms
Turn Off Time	toff	—	250	400	ms

Connector Pin Assignment

Pin No.	Signal	Function	
1	GND	OV	Power Supply
2	V _{DD}	5V	
3	V _O	LCD Drive Voltage (OV to V _{DD})	
4	RS	"H" Data Input "L" Command Input	
5	R/W	"H" Data Read (Module → CPU) "L" Data Write (CPU → Module)	
6	E	Enable Signal	
7	DB0	Data Bus } 8-bit Use } 4-bit Use	
8	DB1		
9	DB2		
10	DB3		
11	DB4		
12	DB5		
13	DB6		
14	DB7		

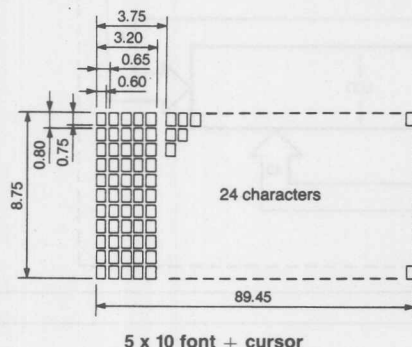


The AND691 is a compact LCD module having a dot matrix LCD panel, a controller and driver circuit. This module can display 160 kinds of letters, numerals, symbols and "Kana" letters, as well as 8 custom characters.

FEATURES

- Compact, integrated display module.
- High contrast, clear display with large characters.
- Low voltage, +5V single power supply.
- Wide operating temperature range (0°C to +50°C).
- 5 x 10 dot character format and cursor line.
- Built-in control LSI with display RAM and character generator ROM.
- Direct interface to 4 or 8 bit CPU.
- 11 commands for control.
- Transflective module is available as an option.

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	126 W x 36 H x 12 D	mm
Character Size	3.2 W x 7.95 H	mm
Number of Characters	24 x 1 (24) Characters (5 x 10 font + cursor)	-
Viewing Area	100 W x 13.8 H	mm
Bezel Opening	100 W x 13.8 H	mm
Dot Size	0.6 W x 0.75 H	mm
Dot Pitch	0.65 W x 0.8 H	mm
Weight	approx. 40	gram

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	7	V
Input Voltage	V_{IN}	$0 \leq V_{IN} \leq V_{DD}$	V
Operating Temperature	T_{op}	0 to +50	°C
Storage Temperature	T_{stg}	-20 to +70	°C

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD}	4.75	5.0	5.25	V
	GND	-	0	-	
"H" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IH}	2.2	-	-	V
"L" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IL}	-	-	0.6	V
"H" Level Output Voltage ($I_{OH} = 0.2\text{mA}$)	V_{OH}	2.4	-	-	V
"L" Level Output Voltage ($I_{OL} = 1.2\text{mA}$)	V_{OL}	-	-	0.4	V
Power Consumption	P_O	-	10	-	mW

Optical Characteristics ($T_A = 25^\circ\text{C}$, $\phi = 25^\circ$, $\theta = 0^\circ$)

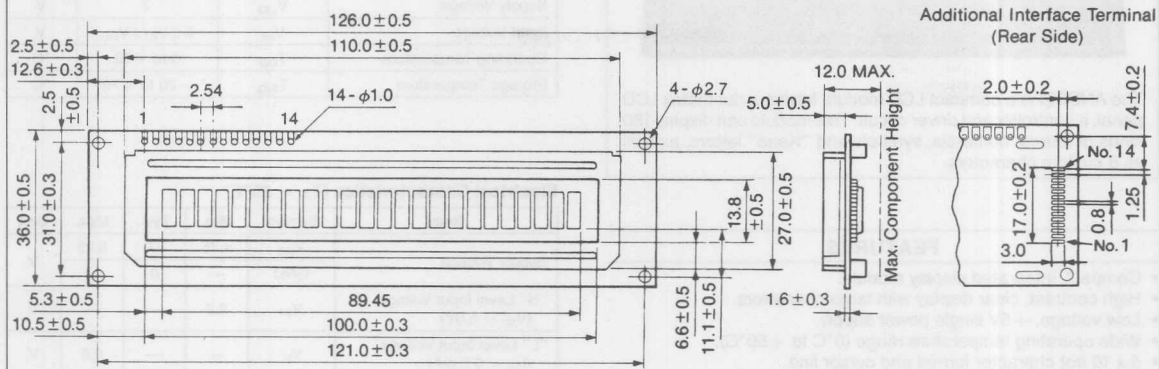
Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	ϕ	10	25	40	degree
Contrast	K	-	3.0	-	-
Turn On Time	t_{on}	-	200	400	ms
Turn Off Time	t_{off}	-	250	400	ms

Note: Refer to Applications Section for the following definitions: (a) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

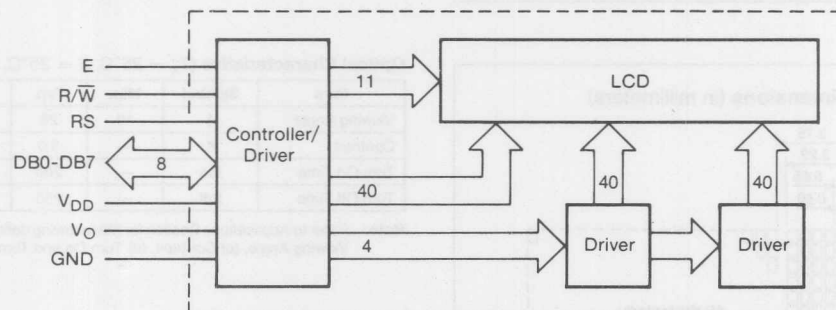
Connector Pin Assignment

Pin No.	Signal	Function
1	GND	Power Supply
2	V_{DD}	
3	V_O	LCD Drive Voltage (OV to V_{DD})
4	RS	"H" Data Input "L" Command Input
5	R/W	"H" Data Read (Module → CPU) "L" Data Write (CPU → Module)
6	E	Enable Signal
7	DB0	Data Bus 8-bit Use
8	DB1	
9	DB2	
10	DB3	
11	DB4	
12	DB5	
13	DB6	
14	DB7	

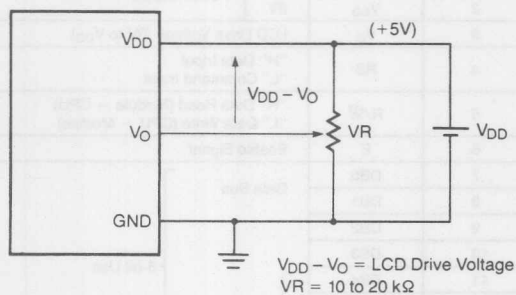
Dimensional Outline (in millimeters)



Block Diagram



Power Supply



Recommended Power Supply for LCD Drive (V_O)
LCD Panel is driven by the voltage V_{DD}-V_O, so adjustable V_O is required for contrast control and temperature compensation.

Temperature	V _O
0°C	0.0V
+25°C	.5V
+50°C	1.0V

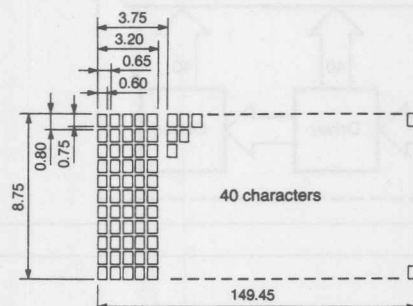


The AND601 is a compact LCD module having a dot matrix LCD panel, a controller and driver circuit. This module can display 160 kinds of letters, numerals, symbols and "Kana" letters, as well as 8 custom characters.

FEATURES

- Compact, integrated display module.
- High contrast, clear display with large characters.
- Low voltage, +5V single power supply.
- Wide operating temperature range (0°C to +50°C).
- 5 x 10 dot character format and cursor line.
- Built-in control LSI with display RAM and character generator ROM.
- Direct interface to 4 or 8 bit CPU
- 11 commands for control.
- Transflective module is available as an option.

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	182W x 33.5H x 13D	mm
Character Size	3.2W x 7.95H	mm
Number of Characters	40 x 1 (40) Characters (5 x 10 font ± cursor)	—
Viewing Area	154.8W x 17.5H	mm
Bezel Opening	154.8W x 17.5H	mm
Dot Size	0.6W x 0.75H	mm
Dot Pitch	0.65W x 0.8H	mm
Weight	approx. 70	gram

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	7	V
Input Voltage	V_{IN}	$0 \leq V_{IN} \leq V_{DD}$	V
Operating Temperature	T_{OP}	0 to +50	°C
Storage Temperature	T_{STG}	-20 to +70	°C

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD}	4.75	5.0	5.25	V
	GND	—	0	—	
"H" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IH}	2.2	—	—	V
"L" Level Input Voltage ($I_{OH} = 0.2\text{mA}$)	V_{IL}	—	—	0.6	V
"L" Level Output Voltage ($I_{OL} = 1.2\text{mA}$)	V_{OL}	—	—	0.4	V
Power Consumption	P_O	—	10	—	mW

Optical Characteristics ($T_A = 25^\circ\text{C}$, $\phi = 25^\circ\text{C}$, $\theta = 0^\circ$)

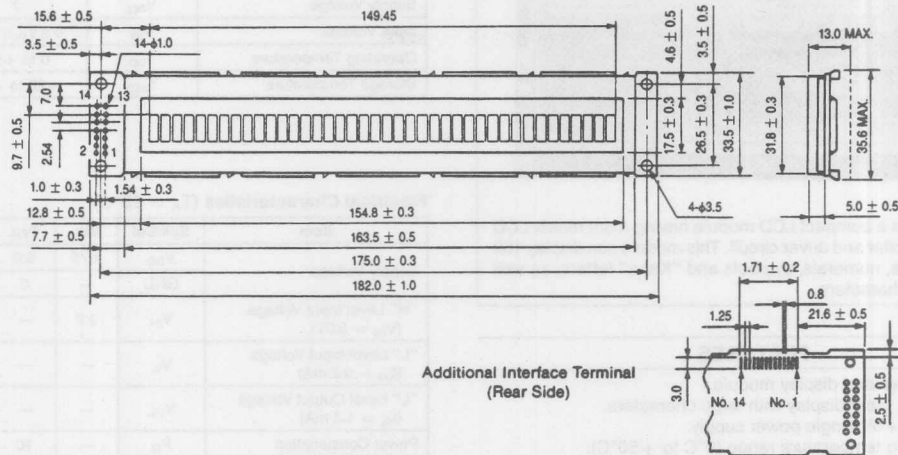
Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	ϕ	10	25	40	degree
Contrast	K	—	3.0	—	—
Turn On Time	t_{ON}	—	200	400	ms
Turn Off Time	t_{OFF}	—	250	400	ms

Note: Refer to Applications Section for the following definitions: (1) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

Connector Pin Assignment

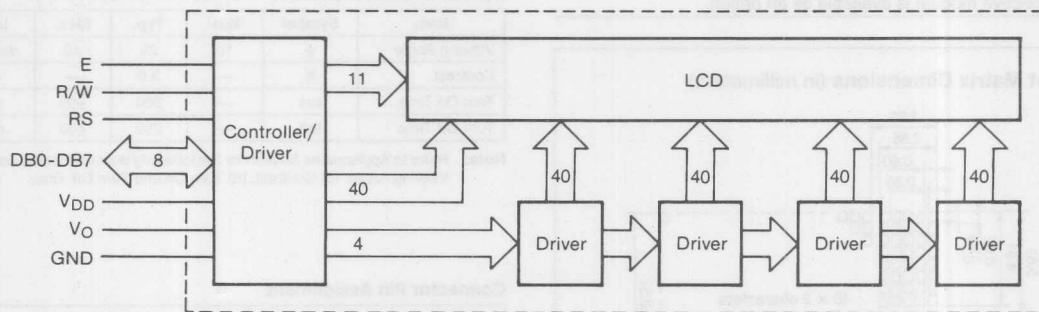
Pin No.	Signal	Function
1	GND	Power Supply
2	V_{DD}	
3	V_O	LCD Drive Voltage (0V to V_{DD})
4	RS	"H" Data Input "L" Command Input
5	R/ \bar{W}	"H" Data Read (Module → CPU) "L" Data Write (CPU → Module)
6	E	Enable Signal
7	DB0	Data Bus 8-bit Use
8	DB1	
9	DB2	
10	DB3	
11	DB4	
12	DB5	
13	DB6	
14	DB7	

Dimensional Outline (in millimeters)



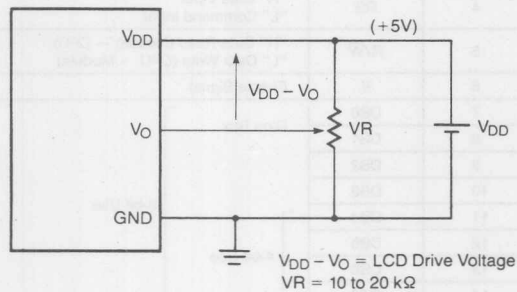
Additional Interface Terminal (Rear Side)

Block Diagram



4

Power Supply



Recommended Power Supply for LCD Drive (V_O)
LCD Panel is driven by the voltage V_{DD} - V_O so adjustable V_O is required for contrast control and temperature compensation.

Temperature	V _O
0°C	0.0V
+25°C	.5V
+50°C	1.0V

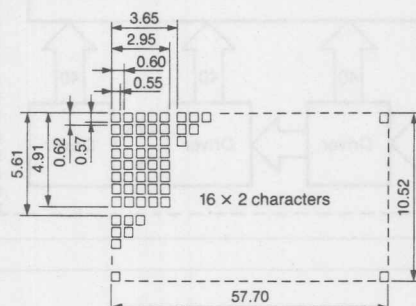


The AND491 is a compact LCD module having a dot matrix LCD panel, a controller and driver circuit. This module can display 160 kinds of letters, numerals, symbols and "Kana" letters, as well as 8 custom characters.

FEATURES

- Compact, integrated display module.
- High contrast, clear display with large characters.
- Low voltage, +5V single power supply.
- Wide operating temperature range (0°C to +50°C).
- 5 x 7 dot character format and cursor line.
- Built-in control LSI with display RAM and character generator ROM.
- Direct interface to 4 or 8 bit CPU
- 11 commands for control.
- Transflective module is available as an option.

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	80W x 36H x 12D	mm
Character Size	2.95W x 4.29H	mm
Number of Characters	16 x 2 (32) Characters (5 x 7 font ± cursor)	—
Viewing Area	64.5W x 15H	mm
Bezel Opening	64.5W x 15H	mm
Dot Size	0.55W x 0.57H	mm
Dot Pitch	0.6W x 0.62H	mm
Weight	approx. 30	gram

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	7	V
Input Voltage	V_{IN}	$0 \leq V_{IN} \leq V_{DD}$	V
Operating Temperature	T_{op}	0 to +50	°C
Storage Temperature	T_{stg}	-20 to +70	°C

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD}	4.75	5.0	5.25	V
	GND	—	0	—	
"H" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IH}	2.2	—	—	V
"L" Level Input Voltage ($I_{OH} = 0.2\text{mA}$)	V_{IL}	—	—	0.6	V
"L" Level Output Voltage ($I_{OL} = 1.2\text{mA}$)	V_{OL}	—	—	0.4	V
Power Consumption	P_O	—	10	—	mW

Optical Characteristics ($T_A = 25^\circ\text{C}$, $\phi = 25^\circ\text{C}$, $\theta = 0^\circ$)

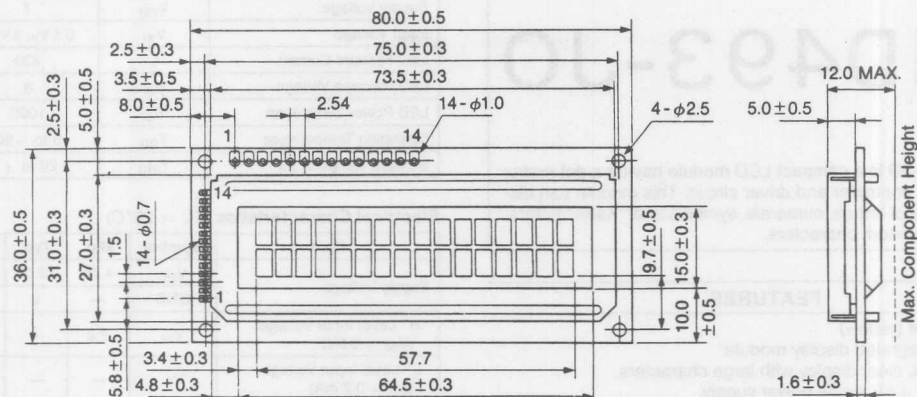
Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	ϕ	10	25	40	degree
Contrast	K	—	3.0	—	—
Turn On Time	t_{on}	—	200	400	ms
Turn Off Time	t_{off}	—	250	400	ms

Note: Refer to Applications Section for the following definitions: (1) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

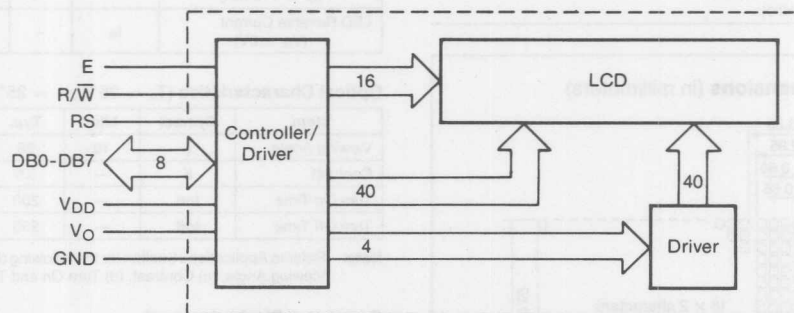
Connector Pin Assignment

Pin No.	Signal	Function		
1	GND	0V	Power Supply	
2	V _{DD}	5V		
3	V _O	LCD Drive Voltage (0V to V _{DD})		
4	RS	"H" Data Input "L" Command Input		
5	R/W	"H" Data Read (Module → CPU) "L" Data Write (CPU → Module)		
6	E	Enable Signal		
7	DB0	Data Bus	8-bit Use	
8	DB1			
9	DB2			
10	DB3			
11	DB4	4-bit Use		
12	DB5			
13	DB6			
14	DB7			

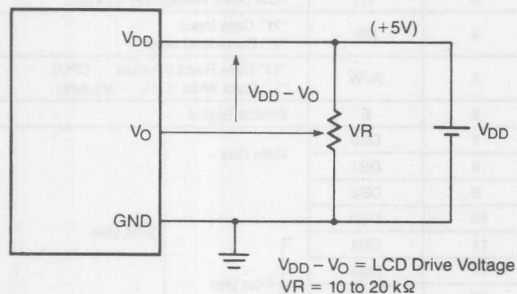
Dimensional Outline (in millimeters)



Block Diagram



Power Supply



Recommended Power Supply for LCD Drive (V_O)
 LCD Panel is driven by the voltage $V_{DD} - V_O$ so adjustable V_O is required for contrast control and temperature compensation.

Temperature	V_O
0°C	0.0V
+25°C	.5V
+50°C	1.0V

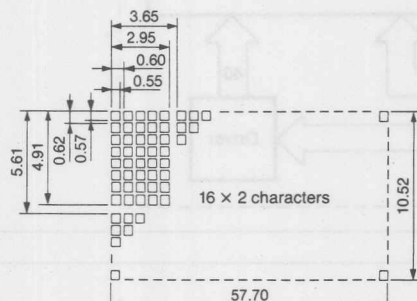
AND493-JO

The AND493-JO is a compact LCD module having a dot matrix LCD panel, a controller and driver circuit. This module can display 160 kinds of letters, numerals, symbols and "Kana" letters, as well as 8 custom characters.

FEATURES

- LED backlight (yellow)
- Compact, integrated display module.
- High contrast, clear display with large characters.
- Low voltage, +5V single power supply.
- Wide operating temperature range (0°C to +50°C).
- 5 x 7 dot character format and cursor line.
- Built-in control LSI with display RAM and character generator ROM.
- Direct interface to 4 or 8 bit CPU
- 11 commands for control.

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	80W x 36H x 12D	mm
Character Size	2.95W x 4.29H	mm
Number of Characters	16 x 2 (32) Characters (5 x 7 font ± cursor)	—
Viewing Area	64.5W x 15H	mm
Bezel Opening	64.5W x 15H	mm
Dot Size	0.55W x 0.57H	mm
Dot Pitch	0.6W x 0.62H	mm
Weight	approx. 30	gram

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V _{DD}	7	V
Input Voltage	V _{IN}	0 ≤ V _{IN} ≤ V _{DD}	V
LED Forward Current	I _F	220	mA
LED Reverse Voltage	V _R	8	V
LED Power Dissipation	P _D	1000	mW
Operating Temperature	T _{OP}	0 to +50	°C
Storage Temperature	T _{stg}	-20 to +70	°C

Electrical Characteristics (T_A = 25°C)

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V _{DD}	4.75	5.0	5.25	V
	GND	—	0	—	
"H" Level Input Voltage (V _{DD} = 5.0V)	V _{IH}	2.2	—	—	V
"L" Level Input Voltage (I _{OH} = 0.2 mA)	V _{IL}	—	—	0.6	V
"L" Level Output Voltage (I _{OL} = 1.2 mA)	V _{OL}	—	—	0.4	V
Power Consumption	P _O	—	10	—	mW
LED Forward Voltage (I _F = 110 mA)	V _F	3.8	4.1	4.4	V
LED Reverse Current (V _R = 8V)	I _R	—	—	1.1	mA

Optical Characteristics (T_A = 25°C, φ = 25°C, θ = 0°)

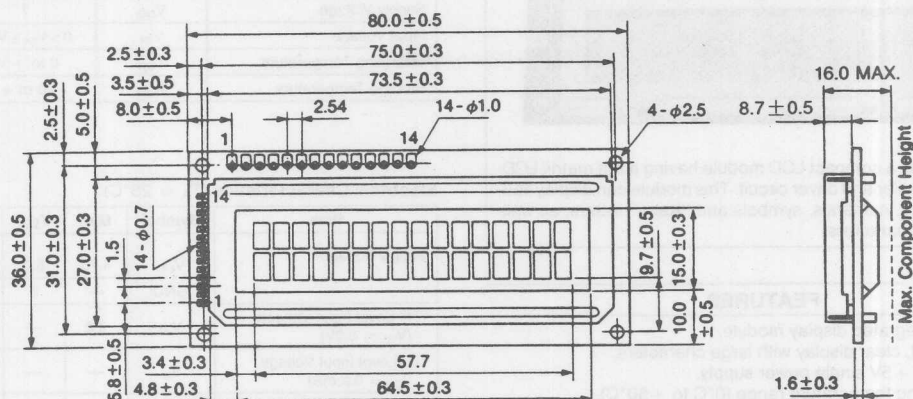
Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	φ	10	25	40	degree
Contrast	K	—	3.0	—	—
Turn On Time	t _{on}	—	200	400	ms
Turn Off Time	t _{off}	—	250	400	ms

Note: Refer to Applications Section for the following definitions: (1) φ and θ, (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

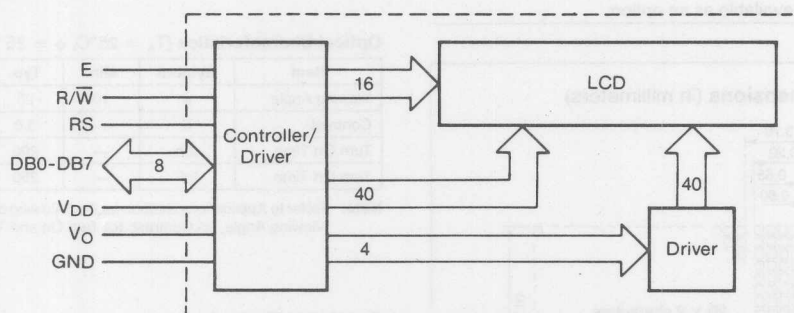
Connector Pin Assignment

Pin No.	Signal	Function	
1	GND	0V	Power Supply
2	V _{DD}	5V	
3	V _O	LCD Drive Voltage (0V to V _{DD})	
4	RS	"H" Data Input "L" Command Input	
5	R/ \bar{W}	"H" Data Read (Module → CPU) "L" Data Write (CPU → Module)	
6	E	Enable Signal	
7	DB0	Data Bus	8-bit Use
8	DB1		
9	DB2		
10	DB3		
11	DB4		
12	DB5		
13	DB6		
14	DB7		

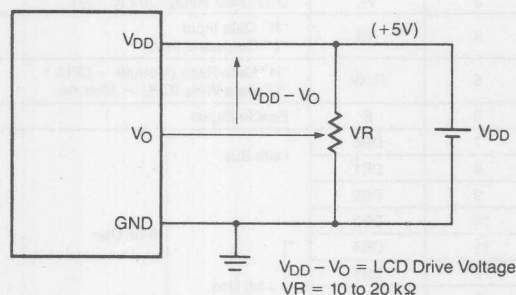
Dimensional Outline (in millimeters)



Block Diagram



Power Supply



Recommended Power Supply for LCD Drive (V_O)
 LCD Panel is driven by the voltage $V_{DD} - V_O$ so adjustable V_O is required for contrast control and temperature compensation.

Temperature	V_O
0°C	0.0V
+25°C	.5V
+50°C	1.0V

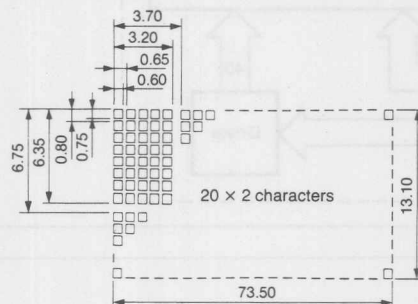


The AND501 is a compact LCD module having a dot matrix LCD panel, a controller and driver circuit. This module can display 160 kinds of letters, numerals, symbols and "Kana" letters, as well as 8 custom characters.

FEATURES

- Compact, integrated display module.
- High contrast, clear display with large characters.
- Low voltage, +5V single power supply.
- Wide operating temperature range (0°C to +50°C).
- 5 x 7 dot character format and cursor line.
- Built-in control LSI with display RAM and character generator ROM.
- Direct interface to 4 or 8 bit CPU
- 11 commands for control.
- EL backlit module is available as an option.

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	116W x 37H x 12.5D	mm
Character Size	3.2W x 5.55H	mm
Number of Characters	20 x 2 (40) Characters (5 x 7 font ± cursor)	—
Viewing Area	83W x 18.6H	mm
Bezel Opening	83W x 18.6H	mm
Dot Size	0.6W x 0.75H	mm
Dot Pitch	0.65W x 0.8H	mm
Weight	approx. 47	gram

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	7	V
Input Voltage	V_{IN}	$0 \leq V_{IN} \leq V_{DD}$	V
Operating Temperature	T_{op}	0 to +50	°C
Storage Temperature	T_{stg}	-20 to +70	°C

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD}	4.75	5.0	5.25	V
	GND	—	0	—	
"H" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IH}	2.2	—	—	V
"L" Level Input Voltage ($I_{OH} = 0.2\text{ mA}$)	V_{IL}	—	—	0.6	V
"L" Level Output Voltage ($I_{OL} = 1.2\text{ mA}$)	V_{OL}	—	—	0.4	V
Power Consumption	P_O	—	10	—	mW

Optical Characteristics ($T_A = 25^\circ\text{C}$, $\phi = 25^\circ\text{C}$, $\theta = 0^\circ$)

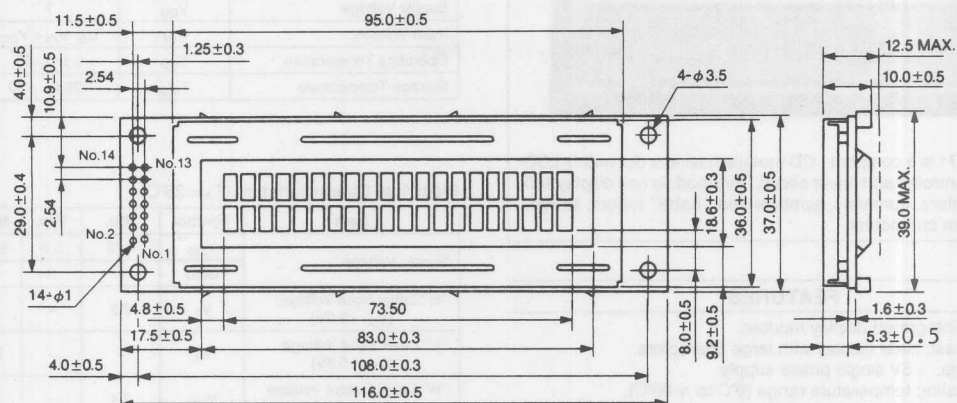
Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	ϕ	10	25	40	degree
Contrast	K	—	3.0	—	—
Turn On Time	t_{on}	—	200	400	ms
Turn Off Time	t_{off}	—	250	400	ms

Note: Refer to Applications Section for the following definitions: (1) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

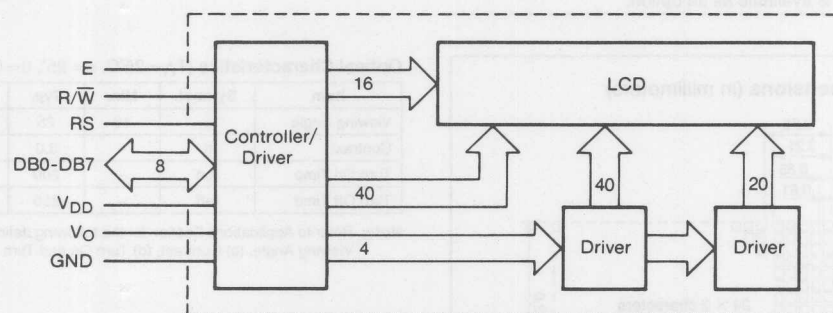
Connector Pin Assignment

Pin No.	Signal	Function
1	GND	Power Supply
2	V_{DD}	
3	V_O	LCD Drive Voltage (0V to V_{DD})
4	RS	"H" Data Input "L" Command Input
5	R/W	"H" Data Read (Module → CPU) "L" Data Write (CPU → Module)
6	E	Enable Signal
7	DB0	Data Bus 8-bit Use
8	DB1	
9	DB2	
10	DB3	
11	DB4	
12	DB5	
13	DB6	
14	DB7	

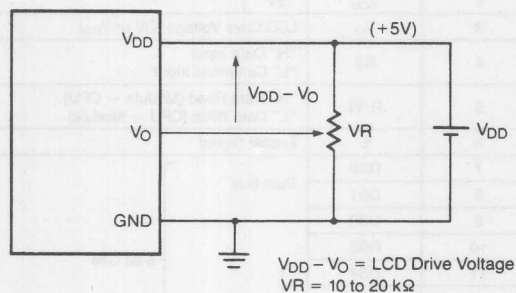
Dimensional Outline (in millimeters)



Block Diagram



Power Supply



Recommended Power Supply for LCD Drive (V_O)
LCD Panel is driven by the voltage V_{DD} - V_O so adjustable V_O is required for contrast control and temperature compensation.

Temperature	V _O
0°C	0.0V
+25°C	.5V
+50°C	1.0V

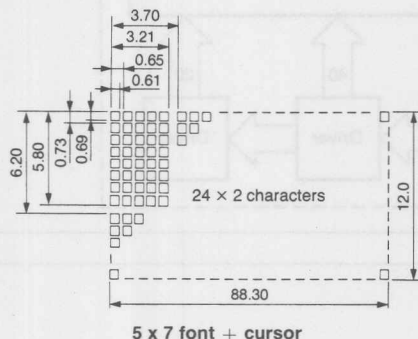


The AND771 is a compact LCD module having a dot matrix LCD panel, a controller and driver circuit. This module can display 160 kinds of letters, numerals, symbols and "Kana" letters, as well as 8 custom characters.

FEATURES

- Compact, integrated display module.
- High contrast, clear display with large characters.
- Low voltage, +5V single power supply.
- Wide operating temperature range (0°C to +50°C).
- 5 x 7 dot character format and cursor line.
- Built-in control LSI with display RAM and character generator ROM.
- Direct interface to 4 or 8 bit CPU.
- 11 commands for control.
- EL backlit module is available as an option.

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	118 W x 36 H x 12 D	mm
Character Size	3.21 W x 5.07 H	mm
Number of Characters	24 x 2 (48) Characters (5 x 7 font + cursor)	-
Viewing Area	93.5 W x 16.5 H	mm
Bezel Opening	94.5 W x 17.9 H	mm
Dot Size	0.61 W x 0.69 H	mm
Dot Pitch	0.65 W x 0.73 H	mm
Weight	approx. 55	gram

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	7	V
Input Voltage	V_{IN}	$0 \leq V_{IN} \leq V_{DD}$	V
Operating Temperature	T_{op}	0 to +50	°C
Storage Temperature	T_{stg}	-20 to +70	°C

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD}	4.75	5.0	5.25	V
	GND	-	0	-	
"H" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IH}	2.2	-	-	V
"L" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IL}	-	-	0.6	V
"H" Level Output Voltage ($I_{OH} = 0.2\text{ mA}$)	V_{OH}	2.4	-	-	V
"L" Level Output Voltage ($I_{OL} = 1.2\text{ mA}$)	V_{OL}	-	-	0.4	V
Power Consumption	P_O	-	10	-	mW

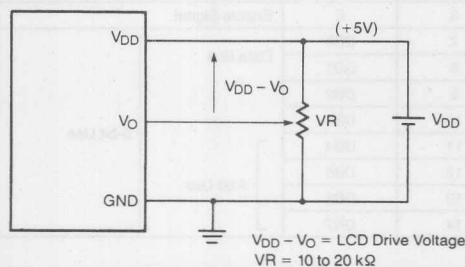
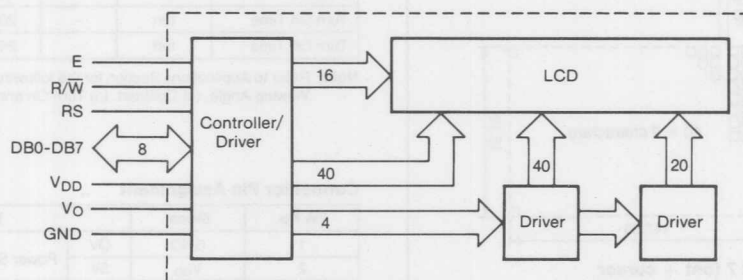
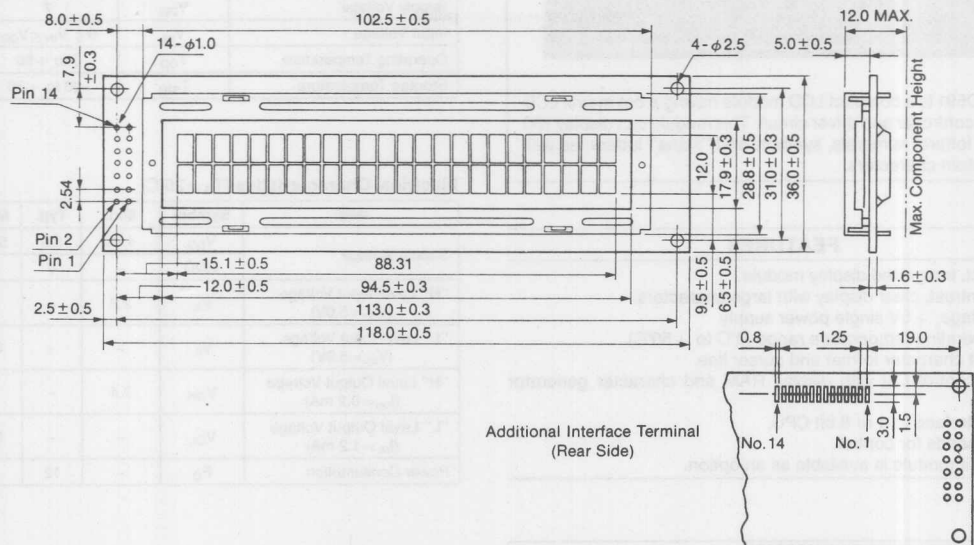
Optical Characteristics ($T_A = 25^\circ\text{C}$, $\phi = 25^\circ$, $\theta = 0^\circ$)

Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	ϕ	10	25	40	degree
Contrast	K	-	3.0	-	-
Turn On Time	t_{on}	-	200	400	ms
Turn Off Time	t_{off}	-	250	400	ms

Note: Refer to Applications Section for the following definitions: (a) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

Connector Pin Assignment

Pin No.	Signal	Function		
1	GND	OV	Power Supply	
2	V _{DD}	5V		
3	V _O	LCD Drive Voltage (OV to V _{DD})		
4	RS	"H" Data Input "L" Command Input		
5	R/W	"H" Data Read (Module → CPU) "L" Data Write (CPU → Module)		
6	E	Enable Signal		
7	DB0	Data Bus	- 8-bit Use	
8	DB1			
9	DB2			
10	DB3			
11	DB4	- 4-bit Use		
12	DB5			
13	DB6			
14	DB7			



LCD Panel is driven by the voltage $V_{DD}-V_O$, so adjustable V_O is required for contrast control and temperature compensation.

Temperature	V_O
0°C	0.0V
+25°C	.5V
+50°C	1.0V

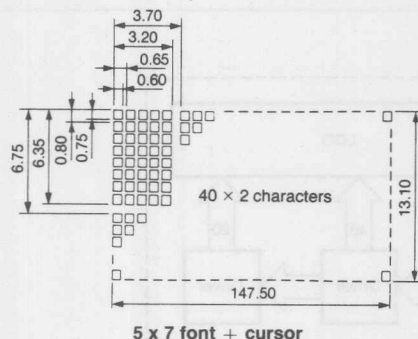


The AND591 is a compact LCD module having a dot matrix LCD panel, a controller and driver circuit. This module can display 160 kinds of letters, numerals, symbols and "Kana" letters, as well as 8 custom characters.

FEATURES

- Compact, integrated display module.
- High contrast, clear display with large characters.
- Low voltage, +5V single power supply.
- Wide operating temperature range (0°C to +50°C).
- 5 x 7 dot character format and cursor line.
- Built-in control LSI with display RAM and character generator ROM.
- Direct interface to 4 or 8 bit CPU.
- 11 commands for control.
- EL backlit module is available as an option.

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	182 W x 33.5 H x 13 D	mm
Character Size	3.2 W x 5.55 H	mm
Number of Characters	40 x 2 (80) Characters (5 x 7 font + cursor)	-
Viewing Area	154.8 W x 17.5 H	mm
Bezel Opening	154.8 W x 17.5 H	mm
Dot Size	0.6 W x 0.75 H	mm
Dot Pitch	0.65 W x 0.8 H	mm
Weight	approx. 70	gram

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	7	V
Input Voltage	V_{IN}	$0 \leq V_{IN} \leq V_{DD}$	V
Operating Temperature	T_{op}	0 to +50	°C
Storage Temperature	T_{stg}	-20 to +70	°C

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD}	4.75	5.0	5.25	V
	GND	-	0	-	
"H" Level Input Voltage ($V_{DD}=5.0\text{V}$)	V_{IL}	2.2	-	-	V
"L" Level Input Voltage ($V_{DD}=5.0\text{V}$)	V_{IL}	-	-	0.6	V
"H" Level Output Voltage ($I_{OH}=0.2\text{mA}$)	V_{OH}	2.4	-	-	V
"L" Level Output Voltage ($I_{OL}=1.2\text{mA}$)	V_{OL}	-	-	0.4	V
Power Consumption	P_O	-	12	-	mW

Optical Characteristics ($T_A = 25^\circ\text{C}$, $\phi = 25^\circ$, $\theta = 0^\circ$)

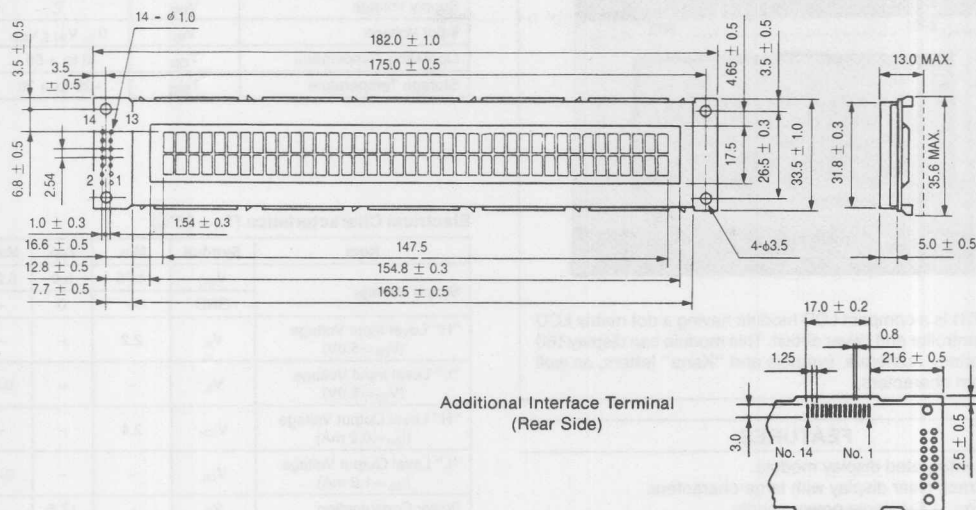
Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	ϕ	10	25	40	degree
Contrast	K	-	3.0	-	-
Turn On Time	t_{on}	-	200	400	ms
Turn Off Time	t_{off}	-	250	400	ms

Note: Refer to Applications Section for the following definitions: (a) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

Connector Pin Assignment

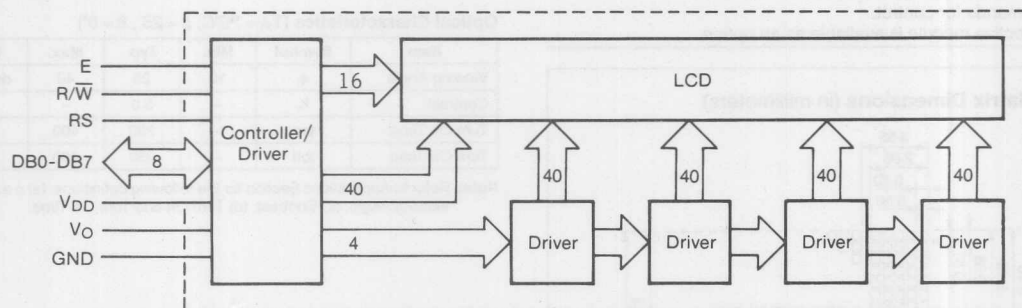
Pin No.	Signal	Function	
1	GND	OV	Power Supply
2	V _{DD}	5V	
3	V ₀	LCD Drive Voltage (OV to V _{DD})	
4	RS	"H" Data Input "L" Command Input	
5	R/W	"H" Data Read (Module → CPU) "L" Data Write (CPU → Module)	
6	E	Enable Signal	
7	DB0	Data Bus	} 8-bit Use
8	DB1		
9	DB2		
10	DB3		
11	DB4		
12	DB5		
13	DB6		
14	DB7		

Dimensional Outline (in millimeters)



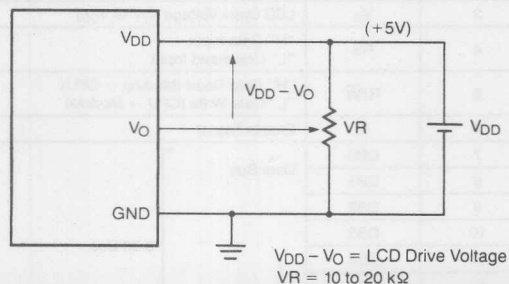
Additional Interface Terminal (Rear Side)

Block Diagram



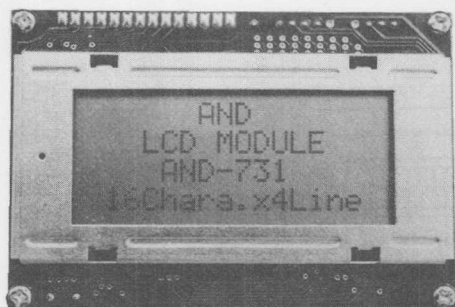
4

Power Supply



Recommended Power Supply for LCD Drive (V_O)
LCD Panel is driven by the voltage V_{DD}-V_O, so adjustable V_O is required for contrast control and temperature compensation.

Temperature	V _O
0°C	0.0V
+25°C	.5V
+50°C	1.0V

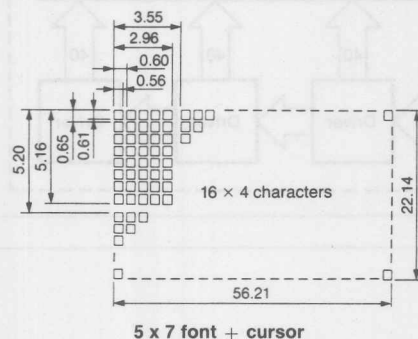


The AND731 is a compact LCD module having a dot matrix LCD panel, a controller and driver circuit. This module can display 160 kinds of letters, numerals, symbols and "Kana" letters, as well as 8 custom characters.

FEATURES

- Compact, integrated display module.
- High contrast, clear display with large characters.
- Low voltage, +5V single power supply.
- Wide operating temperature range (0°C to +50°C).
- 5 x 7 dot character format and cursor line.
- Built-in control LSI with display RAM and character generator ROM.
- Direct interface to 4 or 8 bit CPU.
- 11 commands for control.
- Transflective module is available as an option.

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	87 W x 60 H x 12 D	mm
Character Size	2.96 W x 4.51 H	mm
Number of Characters	16 x 4 (64) Characters (5 x 7 font + cursor)	-
Viewing Area	61.8 W x 26.6 H	mm
Bezel Opening	61.8 W x 26.6 H	mm
Dot Size	0.56 W x 0.61 H	mm
Dot Pitch	0.6 W x 0.65 H	mm
Weight	approx. 60	gram

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	7	V
Input Voltage	V_{IN}	$0 \leq V_{IN} \leq V_{DD}$	V
Operating Temperature	T_{op}	0 to +50	°C
Storage Temperature	T_{stg}	-20 to +70	°C

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD}	4.75	5.0	5.25	V
	GND	-	0	-	
"H" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IH}	2.2	-	-	V
"L" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IL}	-	-	0.6	V
"H" Level Output Voltage ($I_{OH} = 0.2\text{mA}$)	V_{OH}	2.4	-	-	V
"L" Level Output Voltage ($I_{OL} = 1.2\text{mA}$)	V_{OL}	-	-	0.4	V
Power Consumption	P_O	-	17.5	-	mW

Optical Characteristics ($T_A = 25^\circ\text{C}$, $\phi = 25^\circ$, $\theta = 0^\circ$)

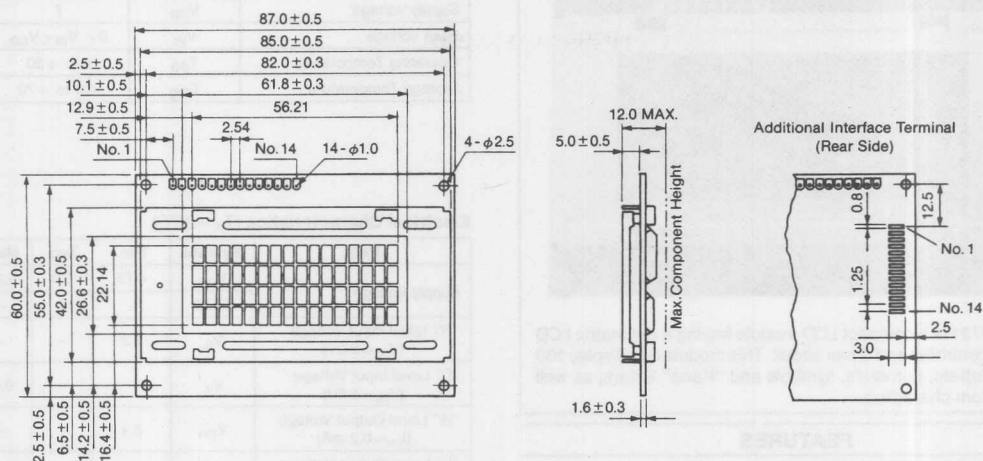
Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	ϕ	10	25	40	degree
Contrast	K	-	3.0	-	-
Turn On Time	t_{on}	-	200	400	ms
Turn Off Time	t_{off}	-	250	400	ms

Note: Refer to Applications Section for the following definitions: (a) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

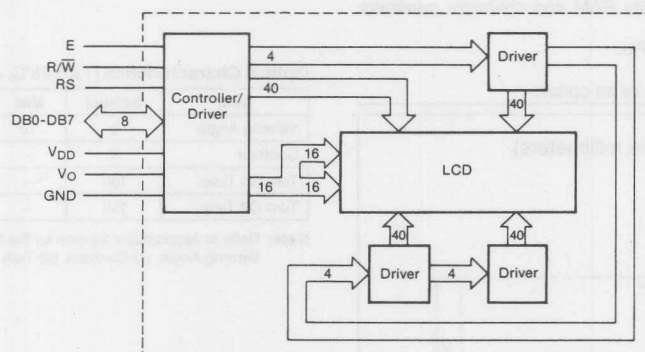
Connector Pin Assignment

Pin No.	Signal	Function
1	GND	Power Supply
2	V_{DD}	
3	V_O	LCD Drive Voltage (OV to V_{DD})
4	RS	"H" Data Input "L" Command Input
5	R/ \bar{W}	"H" Data Read (Module \rightarrow CPU) "L" Data Write (CPU \rightarrow Module)
6	E	Enable Signal
7	DB0	Data Bus 8-bit Use
8	DB1	
9	DB2	
10	DB3	
11	DB4	
12	DB5	
13	DB6	
14	DB7	4-bit Use

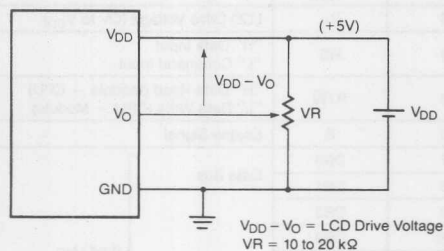
Dimensional Outline (in millimeters)



Block Diagram

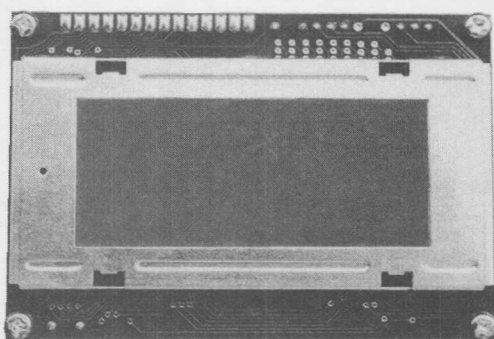


Power Supply



Recommended Power Supply for LCD Drive (V_O)
 LCD Panel is driven by the voltage V_{DD}-V_O, so adjustable V_O is required for contrast control and temperature compensation.

Temperature	V _O
0°C	0.0V
+25°C	.5V
+50°C	1.0V

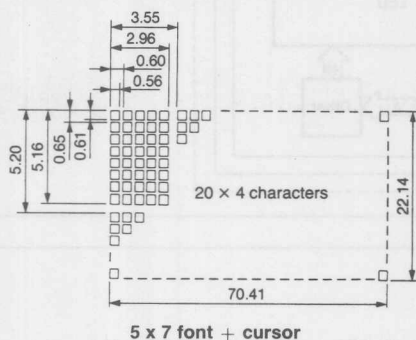


The AND721 is a compact LCD module having a dot matrix LCD panel, a controller and driver circuit. This module can display 160 kinds of letters, numerals, symbols and "Kana" letters, as well as 8 custom characters.

FEATURES

- Compact, integrated display module.
- High contrast, clear display with large characters.
- Low voltage, +5V single power supply.
- Wide operating temperature range (0°C to +50°C).
- 5 x 7 dot character format and cursor line.
- Built-in control LSI with display RAM and character generator ROM.
- Direct interface to 4 or 8 bit CPU.
- 11 commands for control.
- EL backlit module is available as an option.

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	98 W x 60 H x 12 D	mm
Character Size	2.96 W x 4.51 H	mm
Number of Characters	20 x 4 (80) Characters (5 x 7 font + cursor)	-
Viewing Area	76 W x 27 H	mm
Bezel Opening	76 W x 27 H	mm
Dot Size	0.56 W x 0.61 H	mm
Dot Pitch	0.6 W x 0.65 H	mm
Weight	approx. 65	gram

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	7	V
Input Voltage	V_{IN}	$0 \leq V_{IN} \leq V_{DD}$	V
Operating Temperature	T_{op}	0 to +50	°C
Storage Temperature	T_{stg}	-20 to +70	°C

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD}	4.75	5.0	5.25	V
	GND	-	0	-	
"H" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IH}	2.2	-	-	V
"L" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IL}	-	-	0.6	V
"H" Level Output Voltage ($I_{OH} = 0.2\text{ mA}$)	V_{OH}	2.4	-	-	V
"L" Level Output Voltage ($I_{OL} = 1.2\text{ mA}$)	V_{OL}	-	-	0.4	V
Power Consumption	P_O	-	15	-	mW

Optical Characteristics ($T_A = 25^\circ\text{C}$, $\phi = 25^\circ$, $\theta = 0^\circ$)

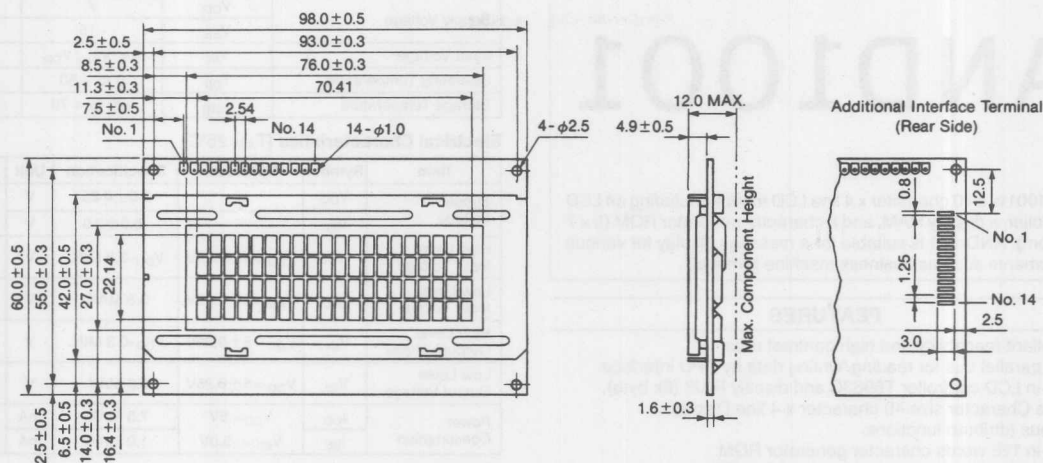
Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	ϕ	10	25	40	degree
Contrast	K	-	3.0	-	-
Turn On Time	t_{on}	-	200	400	ms
Turn Off Time	t_{off}	-	250	400	ms

Note: Refer to Applications Section for the following definitions: (a) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

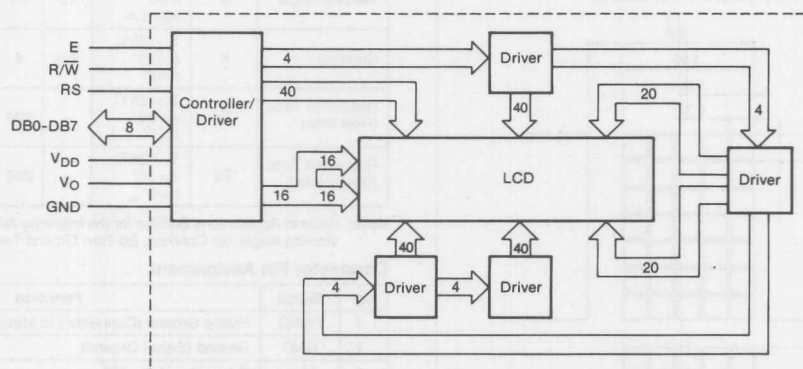
Connector Pin Assignment

Pin No.	Signal	Function	
1	GND	OV	Power Supply
2	V _{DD}	5V	
3	V _O	LCD Drive Voltage (OV to V _{DD})	
4	RS	"H" Data Input "L" Command Input	
5	R/W	"H" Data Read (Module → CPU) "L" Data Write (CPU → Module)	
6	E	Enable Signal	
7	DB0	Data Bus	8-bit Use
8	DB1		
9	DB2		
10	DB3		
11	DB4	4-bit Use	
12	DB5		
13	DB6		
14	DB7		

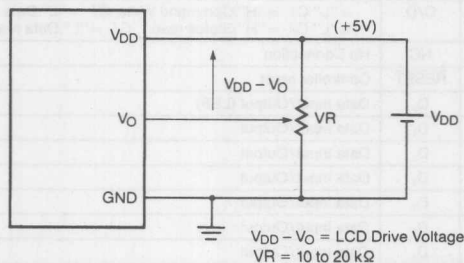
Dimensional Outline (in millimeters)



Block Diagram



Power Supply



Recommended Power Supply for LCD Drive (V₀)
 LCD Panel is driven by the voltage V_{DD}-V₀, so adjustable V₀ is required for contrast control and temperature compensation.

Temperature	V ₀
0°C	0.0V
+25°C	.5V
+50°C	1.0V

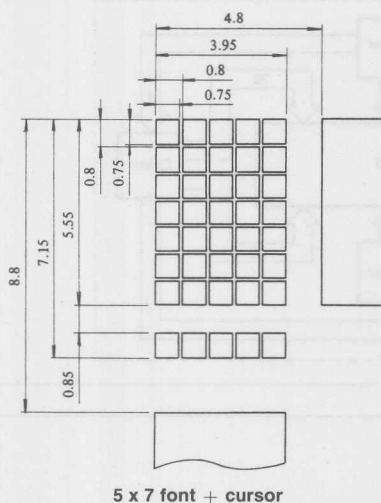
AND1001

AND1001 is a 40 character x 4 line LCD module including an LCD controller, a display RAM, and a character generator ROM (5 x 7 dot font). AND1001 is suitable for a message display for various instruments such as business machine terminals.

FEATURES

- Excellent readability and high contrast ratio.
- 8-bit parallel bus for reading/writing data by CPU interface.
- Built-in LCD controller T6963C and display RAM (8k byte).
- Large Character size 40 character x 4 line Display.
- Various attribute functions.
- Built-in 128 words character generator ROM.
- Wide operating temperature range (0 to 50°C).
- Compact and easily mounted on any equipment.

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	221.0 W x 76.0 H x 12.5 D	mm
Number of Dots	200 (Horizontal) x 32 (Vertical)	-
Number of Characters	40 x 4 (320) Characters (5 x 7 dot format, alpha-numeric)	-
Viewing Area	199.0 W x 44.0 H	mm
Bezel Opening	199.0 W x 44.0 H	mm
Dot Size	0.75 W x 0.75 H	mm
Dot Pitch	0.80 W x 0.80 H	mm
Weight	approx. 240	gram

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V _{DD}	7	V
	V _{EE}	-15	V
Input Voltage	V _{IN}	0 ≤ V _{IN} ≤ V _{DD}	V
Operating Temperature	T _{OP}	0 to +50	°C
Storage Temperature	T _{STG}	-20 to +70	°C

Electrical Characteristics (T_A = 25°C)

Item	Symbol	Condition	Specification	Unit	Note
Supply Voltage	V _{DD}	-	5.0 ± 0.25	V	
	V _{EE}	-	-5.0 ± 2.0	V	
High Level Input Voltage	V _{IH}	V _{DD} = 4 ± 0.25V	V _{DD} - 2.2 MIN.	V	
Low Level Input Voltage	V _{IL}	V _{DD} = 5 ± 0.25V	0.8 MAX.	V	
High Level Output Voltage	V _{OH}	V _{DD} = 5 ± 0.25V	V _{DD} - 0.3 MIN.	V	
Low Level Output Voltage	V _{OL}	V _{DD} = 5 ± 0.25V	0.3 MAX.	V	
Power Consumption	I _{DD}	V _{DD} = 5V	7.5 MAX.	mA	1
	I _{EE}	V _{EE} = -5.0V	1.0 MAX.	mA	

Note 1: In case of all dots on.

Optical Characteristics

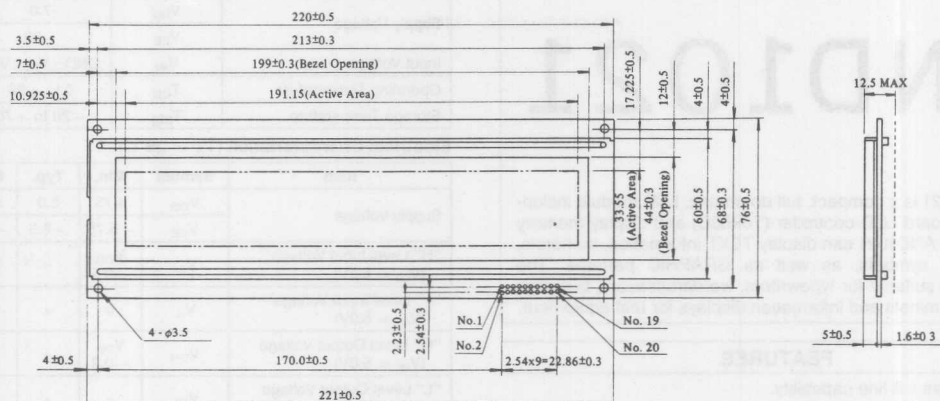
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Viewing Angle	φ	T _A = 25°C θ = 0° K ≥ 1.4	10	25	40	Degree	1, 2
Contrast	K	T _A = 25°C φ = 25° θ = 0°	2.5	4	-	-	1, 3
Response Time (Rise time)	T _r	T _A = 25°C φ = 25° θ = 0°	-	200	350	ms	1, 4
Response Time (Decay time)	T _d	T _A = 25°C φ = 25° θ = 0°	-	250	350	ms	1, 4

Note: Refer to Applications Section for the following definitions: (a) φ and θ, (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

Connector Pin Assignment

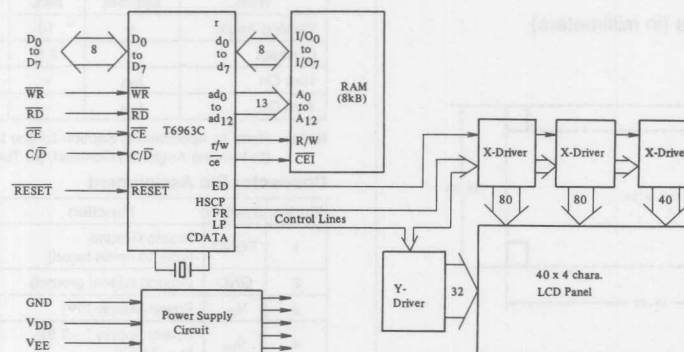
No.	Signal	Function
1	FGND	Frame Ground (Connected to Metal Bezel)
2	GND	Ground (Signal Ground)
3	V _{DD}	Power Supply (+5V)
4	V _{EE}	Power Supply (-3.0 to -7.0V Variable)
5	WR	Data Write (Write data into TLC-1001 at "L")
6	RD	Data read (Read data from TLC-1001 at "L")
7	CE	Chip enable for TLC-1001
8	C/D	"L": C/ = "H": Command Write, C/ = "L": Data write "L": C/ = "H": Status read, C/ = "L": Data read
9	NC	No Connection
10	RESET	Controller reset
11	D ₀	Data Input/Output (LSB)
12	D ₁	Data Input/Output
13	D ₂	Data Input/Output
14	D ₃	Data Input/Output
15	D ₄	Data Input/Output
16	D ₅	Data Input/Output
17	D ₆	Data Input/Output
18	D ₇	Data Input/Output (MSB)
19	NC	No Connection
20	NC	No Connection

Dimensional Outline



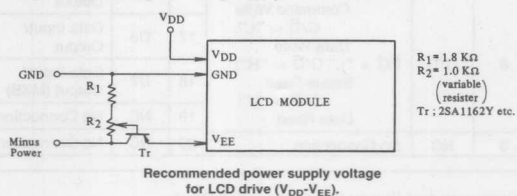
Block Diagram

AND-1001 needs two power sources V_{DD} for logic circuit and V_{EE} for LCD drive.



Note: It is necessary to guard all signals from external noise as signal lines are directly connected to CMOS and are not pulled up or down internally excluding RESET which is pulled up to V_{DD} .

Example of variable negative voltage supply circuit is shown below.



As LCD panel is driven by the voltage of $V_{DD}-V_{EE}$, adjustable V_{EE} is required for contrast control and temperature compensation.

Temperature (°C)	$V_{DD}-V_{EE}(V)$
0	11.5
25	10.0
50	8.5

Note: Please refer to the medium size graphic LCD interface application note. Only operations dealing with text should be considered.

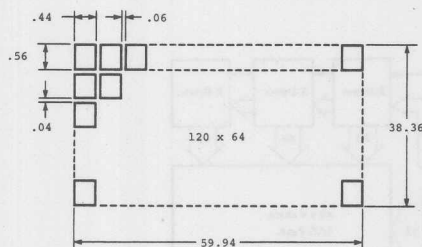
AND1021

The AND1021 is a compact, full dot matrix, LCD module including an on board LCD controller (T6963C) and display memory (RAM). The AND1021 can display TEXT information, numerals, letters and symbols, as well as GRAPHIC patterns. The AND1021 is suitable for typewriters, wordprocessors, business machine terminals and information displays for test equipment.

FEATURES

- 15 characters x 8 line capability.
- 120 x 64 dots graphic display.
- Excellent readability and high contrast ratio.
- Built-in LCD controller (T6963C).
- Wide operating temperature range (0 to 50°C).
- Available with EL backlighting attached (—EO option).

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	85.0 (W) x 70.0 (H) x 20.0 MAX (D)	mm
Number of Dots	120 x 64 Dots (15)	
Number of Characters	15 x 8 (120) Characters, 8 x 8 font	
Viewing Area	62.5 (W) x 43.5 (H)	mm
Bezel Opening	62.5 (W) x 43.5 (H)	mm
Dot Size	0.44 (W) x 0.56 (H)	mm
Dot Pitch	0.50 (W) x 0.60 (H)	mm
Weight	70	gram

Power Supply

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V _{DD}	7.0	V
	V _{EE}	—22	
Input Voltage	V _{IN}	GND ≤ V _{IN} ≤ V _{DD}	V
Operating Temperature	T _{OP}	0 to +50	°C
Storage Temperature	T _{STG}	—20 to +70	°C

Electrical Characteristics (T_A = 25°C)

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V _{DD}	4.75	5.0	5.25	V
	V _{EE}	—5.75	—8.5	—11.5	
"H" Level Input Voltage (V _{DD} = 5.0V)	V _{IH}	V _{DD} —0.5	—	V _{DD}	V
"L" Level Input Voltage (V _{DD} = 5.0V)	V _{IL}	0	—	0.5	V
"H" Level Output Voltage (V _{DD} = 5.0V)	V _{OH}	V _{DD} —0.3	—	—	V
"L" Level Output Voltage (V _{DD} = 5.0V)	V _{OL}	—	—	0.3	V
Power Consumption* (V _{DD} = 5V, V _{EE} = —8.5V)	I _{DD}	—	—	8.0	mA
	I _{EE}	—	—	3.0	

* In case of all dots ON.

Optical Characteristics (T_A = 25°C, φ = 25°C, θ = 0°)

Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	φ	10	25	40	degree
Contrast	K	2.5	4.0	—	—
Turn On	t _{ON}	—	200	350	ms
Turn Off	t _{OFF}	—	250	300	ms

Note: Refer to Applications Section for the following definitions: (a) φ and θ, (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

Connector Pin Assignment

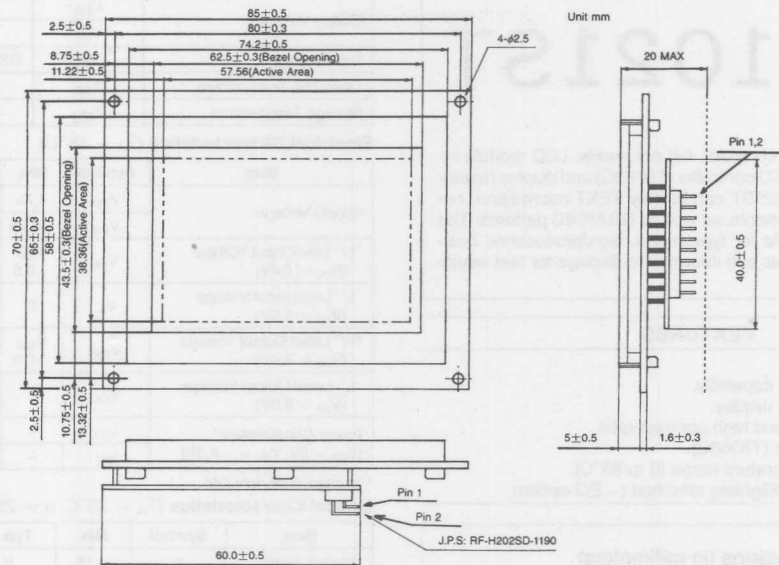
Pin No.	Symbol	Function	Pin	Symbol	Function
1	FGND	Frame Ground (con. to metal bezel)	10	RESET	Controller Reset
2	GND	Ground (signal ground)	11	D0	Data Input/Output (LSB)
3	V _{DD}	Power Supply (5V)	12	D1	Data Input/Output
4	V _{EE}	Power Supply (—5 V to —11.5V)	13	D2	Data Input/Output
5	WR	Data Write (into AND1021 at "L")	14	D3	Data Input/Output
6	RD	Data Read (from AND1021 at "L")	15	D4	Data Input/Output
7	CE	Chip Enable for AND1021	16	D5	Data Input/Output
8	C/D	WR = "L" C/D = "H": Command Write	17	D6	Data Input/Output
		C/D = "L": Data Write	18	D7	Data Input/Output (MSB)
		RD = "L" C/D = "H": Status Read	19	NC	No Connection
		C/D = "L": Data Read	20	NC	No Connection
9	NC	No Connection			

Recommended Power Supply for LCD Drive

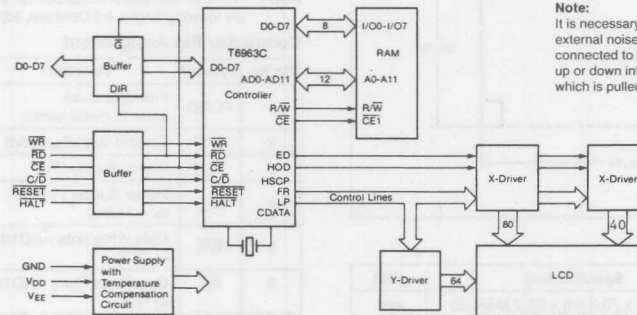
LCD Panel is driven by the voltage (V_{DD} — V_{EE}, so adjustable V_{EE} is required for contrast control and temperature compensation.

Temperature	0°C	+25°C	+50°C
V _{DD} — V _{EE}	14.6V	13.5V	11.6V

Dimensional Outline (in millimeters)



Block Diagram



Note:

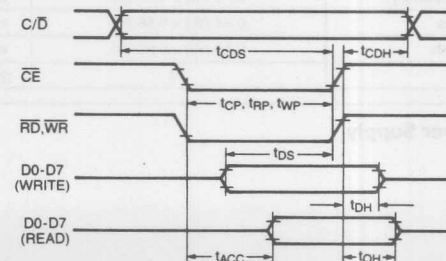
It is necessary to guard all signals from external noise as signal lines are directly connected to CMOS and are not pulled up or down internally excluding RESET which is pulled up to V_{DD} .

Signal Timing

Item	Symbol	Min.	Max.	Unit
C/ \bar{D} Set Up Time	t_{CDS}	150	—	ns
C/ \bar{D} Hold Time	t_{CDH}	50	—	
\overline{CE} , RD, WR Pulse Width	t_{CP} , t_{RP} , t_{WP}	130	—	
Data Set Up Time	t_{DS}	110	—	
Data Hold Time	t_{DH}	80	—	
Access Time	t_{ACC}	—	230	
Output Hold Time	t_{OH}	60	90	

Conditions: $V_{DD} = 5V \pm 0.25V$, $GND = 0V$, $T_A = 0^\circ C$ to $+50^\circ C$

Bus Timing



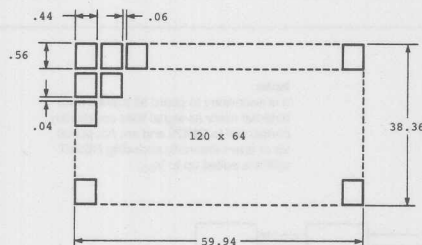
AND1021ST

The AND1021ST is a compact, full dot matrix, LCD module including an on board LCD controller (T6963C) and display memory (RAM). The AND1021ST can display TEXT information, numerals, letters and symbols, as well as GRAPHIC patterns. The AND1021ST is suitable for typewriters, wordprocessors, business machine terminals and information displays for test equipment.

FEATURES

- Super twist.
- 15 characters x 8 line capability.
- 120 x 64 dots graphic display.
- Excellent readability and high contrast ratio.
- Built-in LCD controller (T6963C).
- Wide operating temperature range (0 to 50°C).
- Available with EL backlighting attached (—EO option).

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	85.0 (W) x 70.0 (H) x 20.0 MAX (D)	mm
Number of Dots	120 x 64 Dots (15)	
Number of Characters	15 x 8 (120) Characters, 8 x 8 font	
Viewing Area	62.5 (W) x 43.5 (H)	mm
Bezel Opening	62.5 (W) x 43.5 (H)	mm
Dot Size	0.44 (W) x 0.56 (H)	mm
Dot Pitch	0.50 (W) x 0.60 (H)	mm
Weight	70	gram

Power Supply

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V _{DD}	7.0	V
	V _{EE}	-22	
Input Voltage	V _{IN}	GND ≤ V _{IN} ≤ V _{DD}	V
Operating Temperature	T _{op}	0 to +50	°C
Storage Temperature	T _{stg}	-20 to +60	°C

Electrical Characteristics (T_A = 25°C)

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V _{DD}	4.75	5.0	5.25	V
	V _{EE}	-5.75	-8.5	-11.5	
"H" Level Input Voltage (V _{DD} = 5.0V)	V _{IH}	V _{DD} - 0.5	-	V _{DD}	V
"L" Level Input Voltage (V _{DD} = 5.0V)	V _{IL}	0	-	0.5	V
"H" Level Output Voltage (V _{DD} = 5.0V)	V _{OH}	V _{DD} - 0.3	-	-	V
"L" Level Output Voltage (V _{DD} = 5.0V)	V _{OL}	-	-	0.3	V
Power Consumption* (V _{DD} = 5V, V _{EE} = -8.5V)	I _{DD}	-	-	8.0	mA
	I _{EE}	-	-	3.0	

* In case of all dots ON.

Optical Characteristics (T_A = 25°C, φ = 25°C, θ = 0°)

Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	φ	-15	0	40	degree
Contrast	K	2.5	3.8	-	-
Turn On	t _{ON}	-	200	350	ms
Turn Off	t _{OFF}	-	250	300	ms

Note: Refer to Applications Section for the following definitions: (a) φ and θ, (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

Connector Pin Assignment

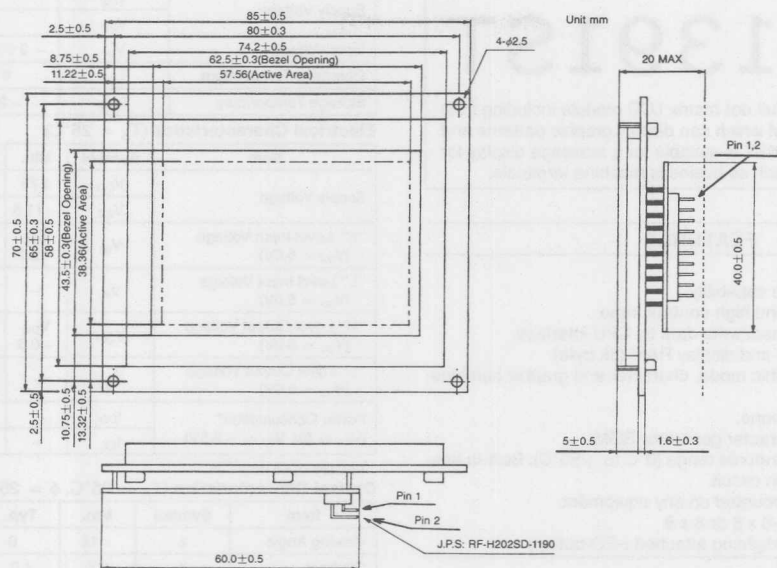
Pin No.	Symbol	Function	Pin	Symb.	Function
1	FGND	Frame Ground (con. to metal bezel)	10	RESET	Controller Reset
2	GND	Ground (signal ground)	11	D0	Data Input/Output (LSB)
3	V _{DD}	Power Supply (5V)	12	D1	Data Input/Output
4	V _{EE}	Power Supply (-5.5V to -11.5V)	13	D2	Data Input/Output
5	WR	Data Write (into AND1021 at "L")	14	D3	Data Input/Output
6	RD	Data Read (from AND1021 at "L")	15	D4	Data Input/Output
7	CE	Chip Enable for AND1021	16	D5	Data Input/Output
8	C/D	WR = "L" C/D = "H": Command Write	17	D6	Data Input/Output
		C/D = "L": Data Write	18	D7	Data Input/Output (MSB)
		RD = "L" C/D = "H": Status Read	19	NC	No Connection
		C/D = "L": Data Read	20	NC	No Connection
9	NC	No Connection			

Recommended Power Supply for LCD Drive

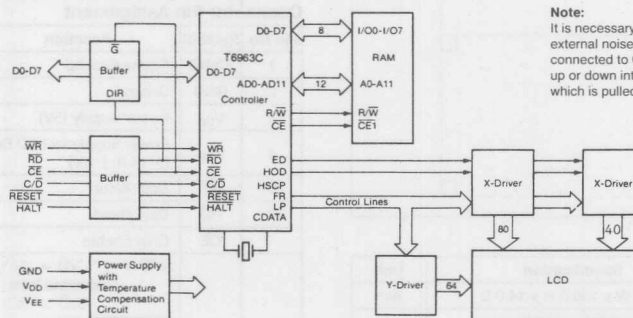
LCD Panel is driven by the voltage (V_{DD} - V_{EE}), so adjustable V_{EE} is required for contrast control and temperature compensation.

Temperature	0°C	+25°C	+50°C
V _{DD} - V _{EE}	14.6V	13.5V	11.6V

Dimensional Outline (in millimeters)



Block Diagram



Note:

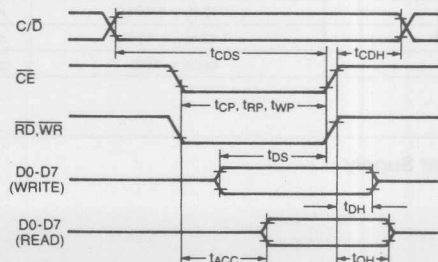
It is necessary to guard all signals from external noise as signal lines are directly connected to CMOS and are not pulled up or down internally excluding RESET which is pulled up to V_{DD} .

Signal Timing

Item	Symbol	Min.	Max.	Unit
C/D Set Up Time	t_{CDS}	100	—	ns
C/D Hold Time	t_{CDH}	10	—	
CE, RD, WR Pulse Width	t_{CP}, t_{RP}, t_{WP}	80	—	
Data Set Up Time	t_{DS}	80	—	
Data Hold Time	t_{DH}	40	—	
Access Time	t_{ACC}	—	150	
Output Hold Time	t_{OH}	10	50	

Conditions: $V_{DD} = 5V \pm 0.25V$, $GND = 0V$, $T_A = 0^\circ C$ to $+50^\circ C$

Bus Timing



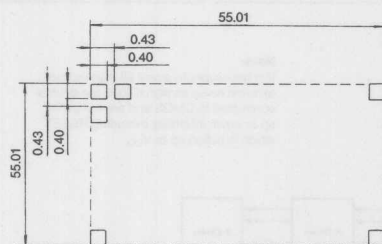
AND1391ST

The AND1391ST is a full dot matrix LCD module including LCD controller, display RAM which can display graphic patterns and symbols. The AND1391ST is suitable for a message display for various instruments such as business machine terminals.

FEATURES

- Super twist
- 21 characters x 16 line capability.
- Excellent readability and high contrast ratio.
- 8-bit parallel bus for read/write data by CPU interface. Built-in LCD controller and display RAM (8k byte).
- Character mode, graphic mode, character and graphic combination mode.
- Various attribute functions.
- Built-in 128 words character generator ROM.
- Wide operating temperatures range (0°C to +50°C). Built-in temperature compensation circuit.
- Compact and easily mounted on any equipment.
- User selectable font—6 x 8 or 8 x 8
- Available with EL backlighting attached (-EO option)

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	84.4 W x 100.0 H x 14.0 D	mm
Number of Dots	128 W x 128 H	—
Number of Characters	16 x 16 (256) Characters 8 x 8 dot format, alpha-numeric	—
Viewing Area	62.0 W x 62.0 H	mm
Bezel Opening	62.0 W x 62.0 H	mm
Dot Size	0.40 W x 0.40 H	mm
Dot Pitch	0.43 w x 0.43 H	mm
Weight	approx. 100	gram

Power Supply

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V _{DD}	7	V
	V _{EE}	—22	
Input Voltage	V _{IN}	—0.3 ≤ V _{IN} ≤ V _{DD} + 0.3	V
Operating Temperature	T _{op}	0 to +50	°C
Storage Temperature	T _{stg}	—20 to +60	°C

Electrical Characteristics (T_A = 25°C)

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V _{DD}	4.75	5.0	5.25	V
	V _{EE}	—11.5	—14.5	—17.5	
"H" Level Input Voltage (V _{DD} = 5.0V)	V _{IH}	V _{DD} — 2.2	—	—	V
"L" Level Input Voltage (V _{DD} = 5.0V)	V _{IL}	—	—	0.8	V
"H" Level Output Voltage (V _{DD} = 5.0V)	V _{OH}	V _{DD} — 0.3	—	—	V
"L" Level Output Voltage (V _{DD} = 5.0V)	V _{OL}	—	—	0.3	V
Power Consumption* (V _{DD} = 5V, V _{EE} = —8.5V)	I _{DD}	—	—	9.0	mA
	I _{EE}	—	—	3.0	

* In case of all dots ON.

Optical Characteristics (T_A = 25°C, φ = 25°, θ = 0°)

Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	φ	—15	0	40	degree
Contrast	K	2.5	4.0	—	—
Turn On Time	t _{on}	—	200	350	ms
Turn Off Time	t _{off}	—	250	350	ms

Note: Refer to Applications Section for the following definitions: (a) φ and θ, (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

Connector Pin Assignment

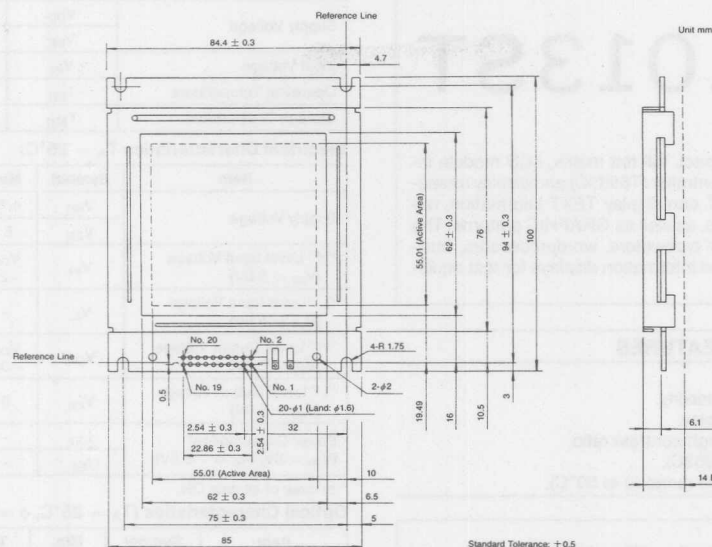
Pin No.	Symbol	Function	Pin	Symb.	Function
1	FGND	Frame Ground			
2	GND	Ground	11	D0	Data Input/ Output (LSB)
3	V _{DD}	Power Supply (5V)			
4	V _{EE}	Power Supply for LCD Drive (−14.0 ± 3V)	12	D1	Data Input/ Output
5	WR	Data Write	13	D2	Data Input/ Output
6	RD	Data Read			
7	CE	Chip Enable	14	D3	Data Input/ Output
8	C/D	WR = "L" C/D = "H": Command Wire C/D = "L": Data Write RD = "L" C/D = "H": Status Read C/D = "L": Data Read	15	D4	Data Input/ Output
			16	D5	Data Input/ Output
			17	D6	Data Input/ Output
			18	D7	Data Input/ Output (MSB)
9	NC				
10	RESET	Controller Reset (Active Pull-Up required)	19	FS	Font select Open or connect to V _{DD} : 6 x 8 dot Connect to GND: 8 x 8 dot
			20	NC	

Recommended Power Supply for LCD Drive

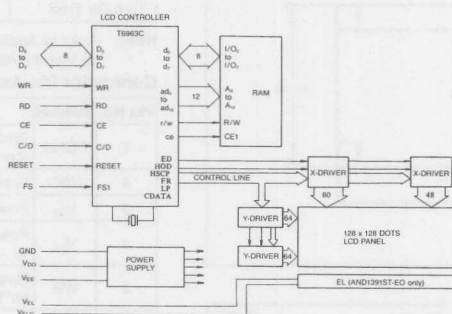
LCD Panel is driven by the voltage V_{DD} — V_{EE}, so adjustable V_{EE} is required for contrast control and temperature compensation.

Temperature	0°C	+25°C	+50°C
V _{DD} — V _{EE}	21.0V	19.5V	18.0V

Dimensional Outline



Block Diagram



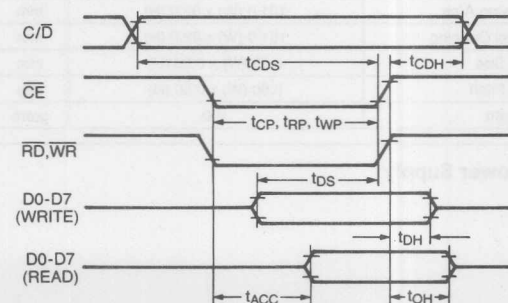
Note: It is necessary to guard all signals from external noise as signal lines are directly connected to CMOS and are not pulled up or down internally excluding RESET which is pulled up to V_{DD}.

Signal Timing

Item	Symbol	Min.	Max.	Unit
C/D Set Up Time	t _{CDS}	100	—	ns
C/D Hold Time	t _{CDH}	10	—	
CE, RD, WR Pulse Width	t _{CP} , t _{RP} , t _{WP}	80	—	
Data Set Up Time	t _{DS}	80	—	
Data Hold Time	t _{DH}	40	—	
Access Time	t _{ACC}	—	150	
Output Hold Time	t _{OH}	10	50	

Conditions: V_{DD} = 5V ± 0.25V, GND = 0V, T_A = 0°C to +50°C

Bus Timing



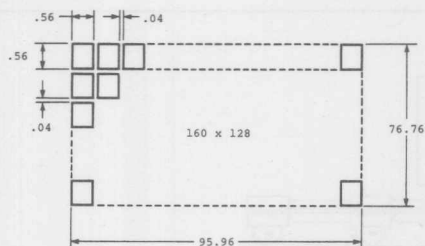
AND1013ST

The AND1013ST is a compact, full dot matrix, LCD module including an on board LCD controller (T6963C) and display memory (RAM). The AND1013ST can display TEXT information, numerals, letters and symbols, as well as GRAPHIC patterns. The AND1013ST is suitable for typewriters, wordprocessors, business machine terminals and information displays for test equipment.

FEATURES

- Super twist.
- 20 characters x 16 line capability.
- 160 x 128 dots graphic display.
- Excellent readability and high contrast ratio.
- Built-in LCD controller (T6963C).
- Wide operating temperature range (0 to 50°C).

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	129.0 (W) x 104.5 (H) x 14.0 MAX (D)	mm
Number of Dots	160 x 128 Dots	
Number of Characters	20 x 16 (320), 8 x 8 font	
Viewing Area	101.0 (W) x 82.0 (H)	mm
Bezel Opening	101.0 (W) x 82.0 (H)	mm
Dot Size	0.56 (W) x 0.56 (H)	mm
Dot Pitch	0.60 (W) x 0.60 (H)	mm
Weight	150	gram

Power Supply

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V _{DD}	7.0	V
	V _{EE}	-15	
Input Voltage	V _{IN}	GND ≤ V _{IN} ≤ V _{DD}	V
Operating Temperature	T _{op}	0 to +50	°C
Storage Temperature	T _{stg}	-20 to +60	°C

Electrical Characteristics T_A = 25°C

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V _{DD}	4.75	5.0	5.25	V
	V _{EE}	-5.75	-8.5	-11.5	
"H" Level Input Voltage (V _{DD} = 5.0V)	V _{IH}	V _{DD} - 2.2	-	V _{DD}	V
"L" Level Input Voltage (V _{DD} = 5.0V)	V _{IL}	-	-	.8	V
"H" Level Output Voltage (V _{DD} = 5.0V)	V _{OH}	V _{DD} - 0.3	-	-	V
"L" Level Output Voltage (V _{DD} = 5.0V)	V _{OL}	0	-	0.3	V
Power Consumption* (V _{DD} = 5V, V _{EE} = -8.5V)	I _{DD}	-	-	10.0	mA
	I _{EE}	-	-	2.2	

* In case of all dots ON.

Optical Characteristics (T_A = 25°C, φ = 25°, θ = 0°)

Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	φ	-15	0	40	degree
Contrast	K	2.5	3.8	-	-
Turn On Time	t _{on}	-	200	350	ms
Turn Off Time	t _{off}	-	250	300	ms

Note: Refer to Applications Section for the following definitions: (a) φ and θ, (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

Connector Pin Assignment

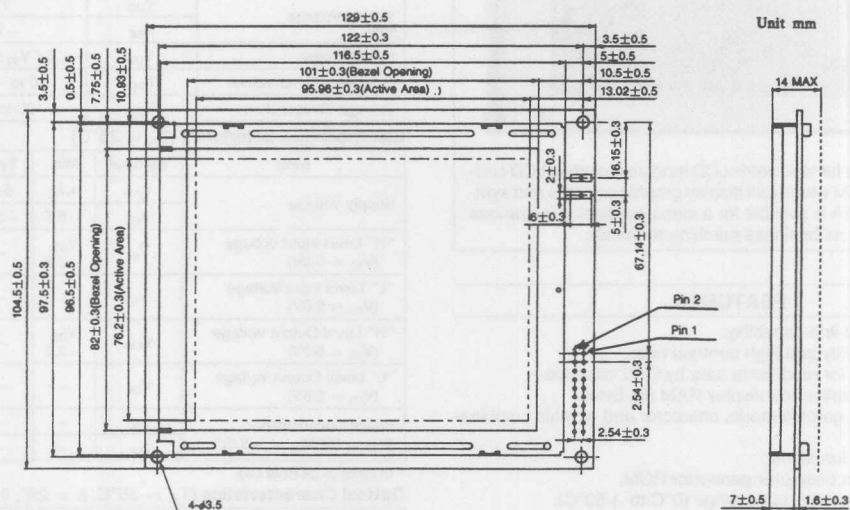
Pin No.	Symbol	Function	Pin	Symb.	Function
1	FGND	Frame Ground (con. to metal bezel)	10	RESET	Controller Reset
2	GND	Ground (signal ground)	11	D0	Data Input/Output (LSB)
3	V _{DD}	Power Supply (5V)	12	D1	Data Input/Output
4	V _{EE}	Power Supply (-5.5V to -11.5V)	13	D2	Data Input/Output
5	WR	Data Write (into AND1013 at "L")	14	D3	Data Input/Output
6	RD	Data Read (from AND1013 at "L")	15	D4	Data Input/Output
7	CE	Chip Enable for AND1013	16	D5	Data Input/Output
8	C/D	WR = "L" C/D = "H": Command Write	17	D6	Data Input/Output
		C/D = "L": Data Write	18	D7	Data Input/Output (MSB)
		RD = "L" C/D = "H": Status Read	19	NC	No Connection
		C/D = "L": Data Read	20	NC	No Connection
9	NC	No Connection			

Recommended Power Supply for LCD Drive

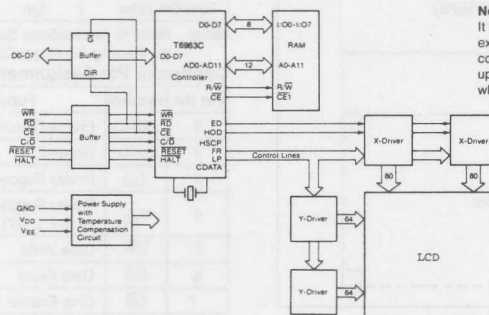
LCD Panel is driven by the voltage (V_{DD} - V_{EE}, so adjustable V_{EE} is required for contrast control and temperature compensation.

Temperature	0°C	+25°C	+50°C
V _{DD} - V _{EE}	14.6	13.5	11.6

Dimensional Outline (in millimeters)



Block Diagram



Note:
It is necessary to guard all signals from external noise as signal lines are directly connected to CMOS and are not pulled up or down internally excluding RESET which is pulled up to V_{DD} .

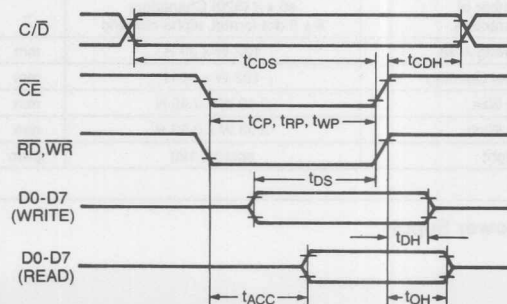
4

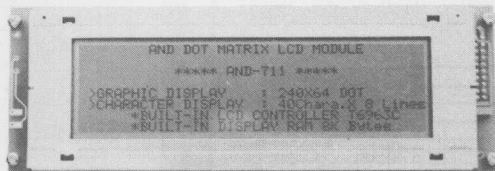
Signal Timing

Item	Symbol	Min.	Max.	Unit
C/D Set Up Time	t_{CDS}	100	—	ns
C/D Hold Time	t_{CDH}	10	—	
CE, RD, WR Pulse Width	t_{CP}, t_{RP}, t_{WP}	80	—	
Data Set Up Time	t_{DS}	80	—	
Data Hold Time	t_{DH}	40	—	
Access Time	t_{ACC}	—	150	
Output Hold Time	t_{OH}	10	50	

Conditions: $V_{DD} = 5V \pm 0.25V$, $GND = 0V$, $T_A = 0^\circ C$ to $+50^\circ C$

Bus Timing



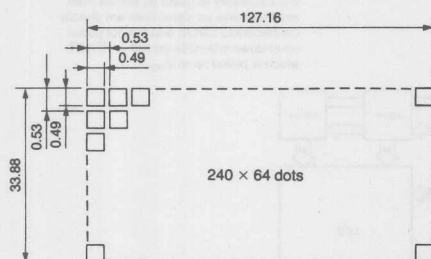


The AND711A is a full dot matrix LCD module including LCD controller, display RAM which can display graphic patterns and symbols. The AND711A is suitable for a message display for various instruments such as business machine terminals.

FEATURES

- 40 characters x 8 line capability.
- Excellent readability and high contrast ratio.
- 8-bit parallel bus for read/write data by CPU interface.
- Built-in LCD controller and display RAM (8k byte).
- Character mode, graphic mode, character and graphic combination mode.
- Various attribute functions.
- Built-in 128 words character generator ROM.
- Wide operating temperatures range (0°C to +50°C).
- Compact and easily mounted on any equipment.
- User selectable font—6 x 8 or 8 x 8
- Available with EL backlighting attached (-EO option)

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	180 W x 65 H x 12 D	mm
Number of Dots	240 W x 64 H	—
Number of Characters	40 x 8 (320) Characters 6 x 8 dot format, alpha-numeric	—
Viewing Area	132 W x 39 H	mm
Bezel Opening	132 W x 39 H	mm
Dot Size	0.49 W x 0.49 H	mm
Dot Pitch	0.53 W x 0.53 H	mm
Weight	approx. 120	gram

Power Supply

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	7	V
	V_{EE}	-15	
Input Voltage	V_{IN}	$-.3 \leq V_{IN} \leq V_{DD} + .3$	V
Operating Temperature	T_{op}	0 to +50	°C
Storage Temperature	T_{stg}	-20 to +70	°C

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD}	4.75	5.0	5.25	V
	V_{EE}	-5.5	-8.5	-11.5	
"H" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IH}	V_{DD} -2.2	—	—	V
"L" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IL}	—	—	0.8	V
"H" Level Output Voltage ($V_{DD} = 5.0\text{V}$)	V_{OH}	V_{DD} -0.3	—	—	V
"L" Level Output Voltage ($V_{DD} = 5.0\text{V}$)	V_{OL}	—	—	0.3	V
Power Consumption* ($V_{DD} = 5\text{V}$, $V_{EE} = -8.5\text{V}$)	I_{DD}	—	—	9.0	mA
	I_{EE}	—	—	2.0	

* In case of all dots ON.

Optical Characteristics ($T_A = 25^\circ\text{C}$, $\phi = 25^\circ$, $\theta = 0^\circ$)

Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	ϕ	10	25	40	degree
Contrast	K	2.5	4.0	—	—
Turn On Time	t_{on}	—	200	350	ms
Turn Off Time	t_{off}	—	250	350	ms

Note: Refer to Applications Section for the following definitions: (a) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

Connector Pin Assignment

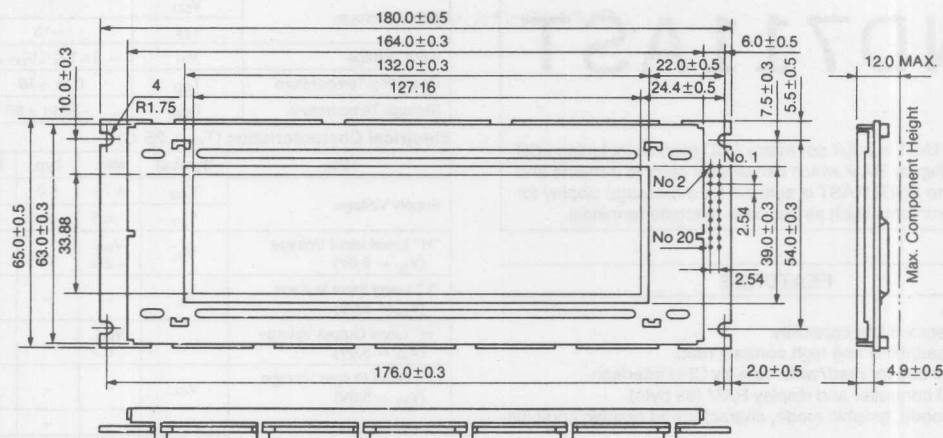
Pin No.	Symbol	Function	Pin	Symb.	Function
1	FGND	Frame Ground			
2	GND	Ground	11	D0	Data Input/Output (LSB)
3	V_{DD}	Power Supply (5V)			
4	V_{EE}	Power Supply for LCD Drive (-8.5 \pm 3V)	12	D1	Data Input/Output
5	\overline{WR}	Data Write	13	D2	Data Input/Output
6	\overline{RD}	Data Read			
7	\overline{CE}	Chip Enable	14	D3	Data Input/Output
8	C/\overline{D}	$\overline{WR} = \text{"L"} \ C/\overline{D} = \text{"H"}:$ Command Wire $C/\overline{D} = \text{"L"}:$ Data Write $\overline{RD} = \text{"L"} \ C/\overline{D} = \text{"H"}:$ Status Read $C/\overline{D} = \text{"L"}:$ Data Read	15	D4	Data Input/Output
			16	D5	Data Input/Output
			17	D6	Data Input/Output
			18	D7	Data Input/Output (MSB)
9	NC				
10	\overline{RESET}	Controller Reset (Active Pull-Up required)	19	FS	Font select Open or connect to V_{DD} : 6 x 8 dot Connect to GND: 8 x 8 dot
			20	NC	

Recommended Power Supply for LCD Drive

LCD Panel is driven by the voltage $V_{DD} - V_{EE}$, so adjustable V_{EE} is required for contrast control and temperature compensation.

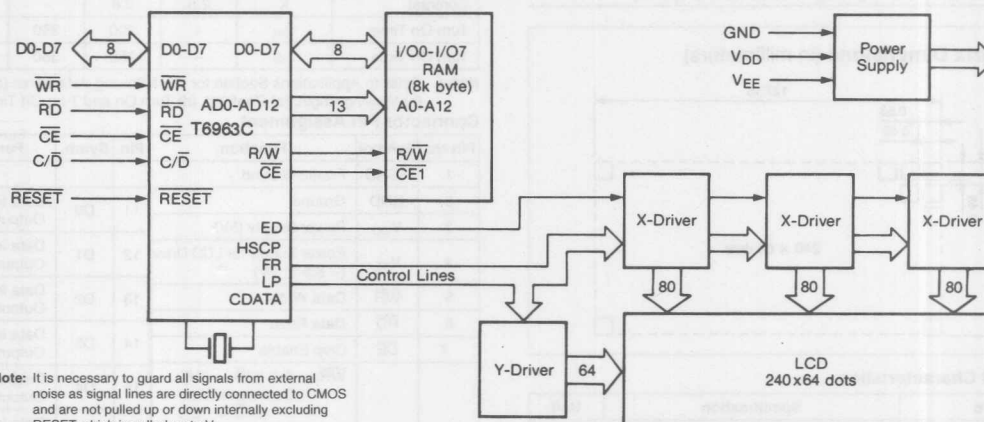
Temperature	0°C	+25°C	+50°C
$V_{DD} - V_{EE}$	14.6V	13.5V	11.6V

Dimensional Outline (in millimeters)



Block Diagram

AND711A needs two power sources, V_{DD} for logic circuit and V_{EE} for LCD drive.

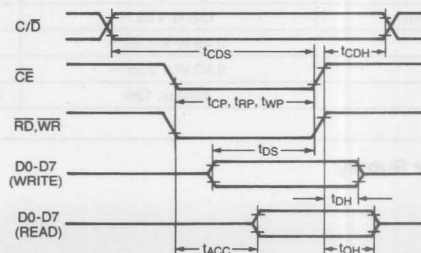


Signal Timing

Item	Symbol	Min.	Max.	Unit
C/D Set Up Time	t_{CDS}	100	-	ns
C/D Hold Time	t_{CDH}	10	-	
CE, RD, WR Pulse Width	t_{CP}, t_{RP}, t_{WP}	80	-	
Data Set Up Time	t_{DS}	80	-	
Data Hold Time	t_{DH}	40	-	
Access Time	t_{ACC}	-	150	
Output Hold Time	t_{OH}	10	50	

Conditions: $V_{DD} = 5V \pm 0.25V$, $GND = 0V$, $T_A = 0^\circ C$ to $+50^\circ C$

Bus Timing



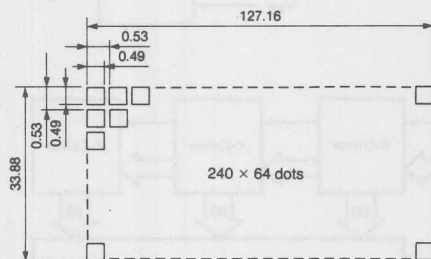
AND711AST

The AND711AST is a full dot matrix LCD module including LCD controller, display RAM which can display graphic patterns and symbols. The AND711AST is suitable for a message display for various instruments such as business machine terminals.

FEATURES

- Super twist.
- 40 characters x 8 line capability.
- Excellent readability and high contrast ratio.
- 8-bit parallel bus for read/write data by CPU interface.
- Built-in LCD controller and display RAM (8k byte).
- Character mode, graphic mode, character and graphic combination mode.
- Various attribute functions.
- Built-in 128 words character generator ROM.
- Wide operating temperatures range (0°C to +50°C).
- Compact and easily mounted on any equipment.
- User selectable font—6 x 8 or 8 x 8
- Available with EL backlighting attached (-EO option)

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	180 W x 65 H x 12 D	mm
Number of Dots	240 W x 64 H	-
Number of Characters	40 x 8 (320) Characters 6 x 8 dot format, alpha-numeric	-
Viewing Area	132 W x 39 H	mm
Bezel Opening	132 W x 39 H	mm
Dot Size	0.49 W x 0.49 H	mm
Dot Pitch	0.53 W x 0.53 H	mm
Weight	approx. 120	gram

Power Supply

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	7	V
	V_{EE}	-15	
Input Voltage	V_{IN}	$-0.3 \leq V_{IN} \leq V_{DD} + 0.3$	V
Operating Temperature	T_{op}	0 to +50	°C
Storage Temperature	T_{stg}	-20 to +60	°C

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD}	4.75	5.0	5.25	V
	V_{EE}	-5.5	-8.5	-11.5	
"H" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IH}	$V_{DD} - 2.2$	-	-	V
"L" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IL}	-	-	0.8	V
"H" Level Output Voltage ($V_{DD} = 5.0\text{V}$)	V_{OH}	$V_{DD} - 0.3$	-	-	V
"L" Level Output Voltage ($V_{DD} = 5.0\text{V}$)	V_{OL}	-	-	0.3	V
Power Consumption* ($V_{DD} = 5\text{V}$, $V_{EE} = -8.5\text{V}$)	I_{DD}	-	-	9.0	mA
	I_{EE}	-	-	2.0	

* In case of all dots ON.

Optical Characteristics ($T_A = 25^\circ\text{C}$, $\phi = 25^\circ$, $\theta = 0^\circ$)

Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	ϕ	-15	0	40	degree
Contrast	K	2.5	3.8	-	-
Turn On Time	t_{on}	-	200	350	ms
Turn Off Time	t_{off}	-	250	350	ms

Note: Refer to Applications Section for the following definitions: (a) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

Connector Pin Assignment

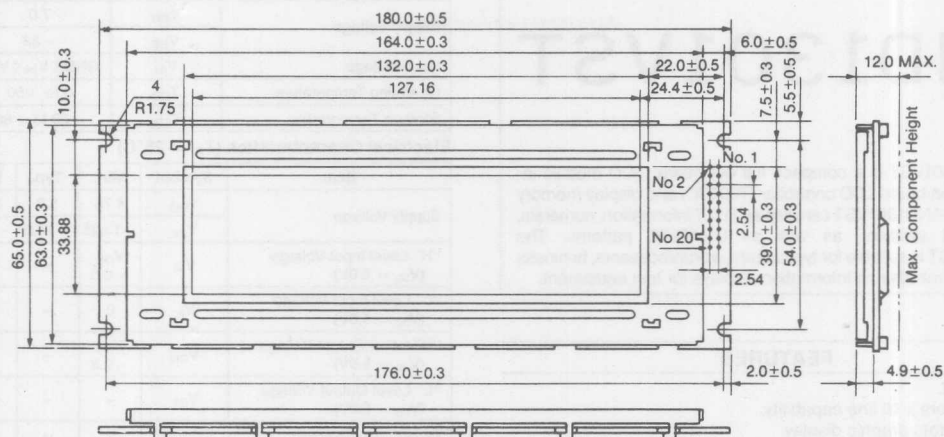
Pin No.	Symbol	Function	Pin	Symbol	Function
1	FGND	Frame Ground			
2	GND	Ground	11	D0	Data Input/Output (LSB)
3	V_{DD}	Power Supply (5V)	12	D1	Data Input/Output
4	V_{EE}	Power Supply for LCD Drive (-8.5 \pm 3V)	13	D2	Data Input/Output
5	\overline{WR}	Data Write	14	D3	Data Input/Output
6	\overline{RD}	Data Read	15	D4	Data Input/Output
7	\overline{CE}	Chip Enable	16	D5	Data Input/Output
8	C/\overline{D}	$\overline{WR} = \text{"L"} \ C/\overline{D} = \text{"H"}:$ Command Wire $C/\overline{D} = \text{"L"}:$ Data Write $\overline{RD} = \text{"L"} \ C/\overline{D} = \text{"H"}:$ Status Read $C/\overline{D} = \text{"L"}:$ Data Read	17	D6	Data Input/Output
			18	D7	Data Input/Output (MSB)
			19	FS	Font select Open or connect to V_{DD} : 6 x 8 dot Connect to GND: 8 x 8 dot
			20	NC	
10	RESET	Controller Reset (Active Pull-Up required)			

Recommended Power Supply for LCD Drive

LCD Panel is driven by the voltage $V_{DD} - V_{EE}$, so adjustable V_{EE} is required for contrast control and temperature compensation.

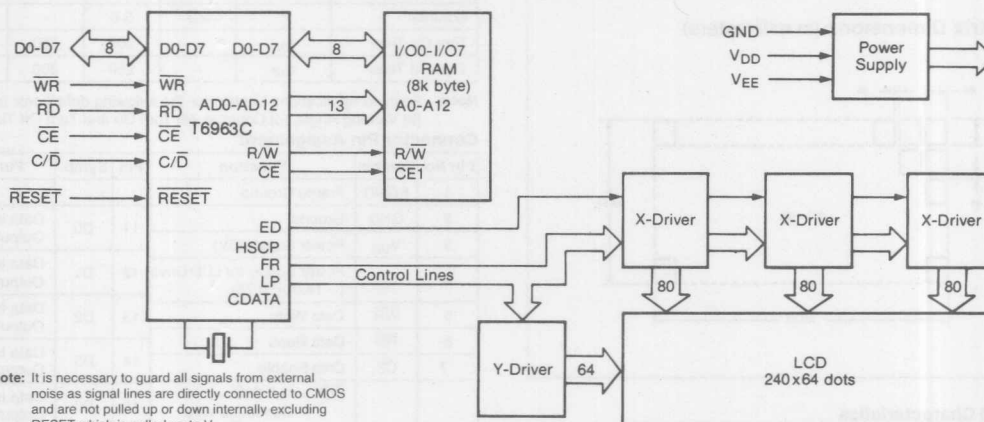
Temperature	0°C	+25°C	+50°C
$V_{DD} - V_{EE}$	14.6V	13.5V	11.6V

Dimensional Outline (in millimeters)



Block Diagram

AND711AST needs two power sources, V_{DD} for logic circuit and V_{EE} for LCD drive.

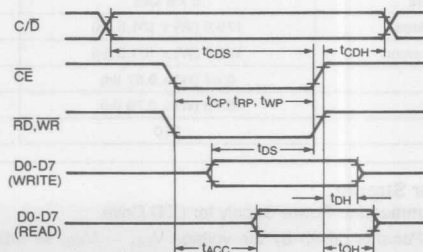


Signal Timing

Item	Symbol	Min.	Max.	Unit
C/ \bar{D} Set Up Time	t_{CDS}	100	-	ns
C/ \bar{D} Hold Time	t_{CDH}	10	-	
$\bar{C}E$, RD, WR Pulse Width	t_{CP} , t_{RP} , t_{WP}	80	-	
Data Set Up Time	t_{DS}	80	-	
Data Hold Time	t_{DH}	40	-	
Access Time	t_{ACC}	-	150	
Output Hold Time	t_{OH}	10	50	

Conditions: $V_{DD} = 5V \pm 0.25V$, $GND = 0V$, $T_A = 0^\circ C$ to $+50^\circ C$

Bus Timing



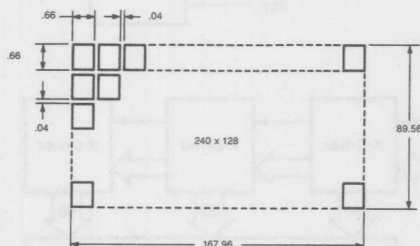
AND1301VST

The AND1301VST is a compact, full dot matrix, LCD module including an on board LCD controller (T6963C) and display memory (RAM). The AND1301VST can display TEXT information, numerals, letters and symbols, as well as GRAPHIC patterns. The AND1301VST is suitable for typewriters, wordprocessors, business machine terminals and information displays for test equipment.

FEATURES

- Super twist.
- 40 characters x 16 line capability.
- 240 x 128 dots graphic display.
- Excellent readability and high contrast ratio.
- Built-in LCD controller (T6963C).
- Wide operating temperature range (0 to 50°C).
- Available with EL backlighting attached (-EO option)

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	241.0 (W) x 125.3 (H) x 13.0 MAX (D)	mm
Number of Dots	240 x 128 Dots (40 Chara. x 16 Line)	
Number of Characters	40 x 16 (480) 6 x 8 font	
Viewing Area	179.9 (W) x 101.5 (H)	mm
Bezel Opening	179.9 (W) x 101.5 (H)	mm
Dot Size	0.67 (W) x 0.67 (H)	mm
Dot Pitch	0.70 (W) x 0.70 (H)	mm
Weight	310	gram

Power Supply

Recommended Power Supply for LCD Drive

LCD Panel is driven by the voltage $V_{DD} - V_{EE}$, so adjustable V_{EE} is required for contrast control and temperature compensation.

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	7.0	V
	V_{EE}	-22	
Input Voltage	V_{IN}	$GND \leq V_{IN} \leq V_{DD}$	V
Operating Temperature	T_{op}	0 to +50	°C
Storage Temperature	T_{stg}	-20 to +60	°C

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD}	4.75	5.0	5.25	V
	V_{EE}	-13.25	-14.0	-14.75	
"H" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IH}	$V_{DD} - 0.5$	-	V_{DD}	V
"L" Level Input Voltage ($V_{DD} = 5.0\text{V}$)	V_{IL}	0	-	0.5	V
"H" Level Output Voltage ($V_{DD} = 5.0\text{V}$)	V_{OH}	$V_{DD} - 0.3$	-	-	V
"L" Level Output Voltage ($V_{DD} = 5.0\text{V}$)	V_{OL}	-	-	0.3	V
Power Consumption* ($V_{DD} = 5\text{V}$, $V_{EE} = -14\text{V}$)	I_{DD}	-	-	17.0	mA
	I_{EE}	-	-	7.0	

* In case of all dots ON.

Optical Characteristics ($T_A = 25^\circ\text{C}$, $\phi = 25^\circ$, $\theta = 0^\circ$)

Item	Symbol	Min.	Typ.	Max.	Unit
Viewing Angle	ϕ	-15	0	40	degree
Contrast	K	2.5	3.8	-	-
Turn On Time	t_{on}	-	200	350	ms
Turn Off Time	t_{off}	-	250	300	ms

Note: Refer to Applications Section for the following definitions: (a) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

Connector Pin Assignment

Pin No.	Symbol	Function	Pin	Symb.	Function
1	FGND	Frame Ground			
2	GND	Ground	11	D0	Data Input/Output (LSB)
3	V_{DD}	Power Supply (5V)			
4	V_{EE}	Power Supply for LCD Drive (-14.0 ± 0.75)	12	D1	Data Input/Output
5	\overline{WR}	Data Write	13	D2	Data Input/Output
6	\overline{RD}	Data Read			
7	\overline{CE}	Chip Enable	14	D3	Data Input/Output
8	C/D	$\overline{WR} = \text{"L"} \text{ C/D} = \text{"H"}:$ Command Wire $\text{C/D} = \text{"L"}:$ Data Write $\overline{RD} = \text{"L"} \text{ C/D} = \text{"H"}:$ Status Read $\text{C/D} = \text{"L"}:$ Data Read	15	D4	Data Input/Output
			16	D5	Data Input/Output
			17	D6	Data Input/Output
			18	D7	Data Input/Output (MSB)
9	NC				
10	RESET	Controller Reset (Active Pull-Up required)	19	FS	Font select Open or connect to V_{DD} : 6 x 8 dot Connect to GND: 8 x 8 dot
			20	NC	

Temperature	0°C	+25°C	+50°C
$V_{DD} - V_{EE}$	20.5	19.0	18.0

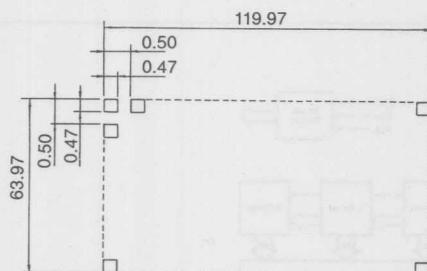
AND1741MST

The AND1741MST is a compact, full dot matrix, LCD module including an on board LCD controller (T6963C) and display memory (RAM). The AND1741MST can display TEXT information, numerals, letters and symbols, as well as GRAPHIC patterns. The AND1741MST is suitable for typewriters, wordprocessors, business machine terminals and information displays for test equipment.

FEATURES

- Black and white ST (M-ST) transmissive mode.
- Built-in CCFL backlight.
- 40 characters x 16 line capability.
- 240 x 128 dots graphic display.
- Excellent readability and high contrast ratio.
- Built-in LCD controller (T6963C).
- Wide operating temperature range (0 to 50°C).

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	170.0 (W) x 105.0 (H) x 14.0 MAX (D)	mm
Number of Dots	240 x 128 Dots (40 chara. x 16 Line)	
Number of Characters	40 x 16 (480) 6 x 8 font	
Viewing Area	126.0 (W) x 70.0 (H)	mm
Bezel Opening	132.0 (W) x 76.0 (H)	mm
Dot Size	0.47 (W) x 0.47 (H)	mm
Dot Pitch	0.50 (W) x 0.50 (H)	mm
Weight		gram

Absolute Maximum Ratings

Item	Symbol	Absolute Maximum Ratings		Unit
		Min.	Max.	
Supply Voltage	V_{DD}	0	7.0	V
	$V_{DD} - V_e$	0	24.0	
	V_{FL}	—	500	Vrms
CCFL Input Current	I_{FL}	—	15	mA rms
CCFL Drive Frequency	f_{FL}	—	35	kHz
Input Voltage	V_{IN}	— 0.3	V_{DD}	V
Storage Temperature	T_{stg}	— 20	60	°C
Operating Temperature	T_{op}	0	50	°C
Humidity Note (1)	—	10	90	% RH

Note (1) Wet bulb temperature ≤ 29 deg. C, no condensation of water.

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Sym- bol	Condition	Specifications			Unit	Note
			Min.	Typ.	Max.		
Supply Voltage	V_{DD}	$T_A = 25^\circ\text{C}$	4.75	5.0	5.25	V	
	V_e		—	— 14.0	—		
	V_{FL}		—	300	—	Vrms	
CCFL Start Voltage	V_S		TBD	—	—	Vrms	
CCFL Drive Frequency	f_{FL}	$T_A = 25^\circ\text{C}$	—	30	35	kHz	(2)
Input Voltage	V_{IH}	$V_{DD} = 5.0\text{V}$	$V_{DD} - 0.5$	5.0	$V_{DD} + 0.3$	V	
	V_{IL}		— 0.3	0	0.5		
Current Consumption 2	I_{DD}	$V_{DD} = 5.0\text{V}$	—	11.5	—	mA	(3)
	I_e	$V_e = -14\text{V}$ $f_{FP} = 72\text{kHz}$	—	2.5	—	mA	(4)
CCFL Input Current	I_{FL}	$f_{FL} = 30\text{kHz}$	—	5.0	—	mA rms	(5)

Note (2) FL drive frequency should be decided in order to prevent flickering with the frame frequency of LCD.

(3) For typical case (all text).

(4) For maximum case (every other "ON" line).

(5) Life time of backlight will decrease according to the input current of CCFL backlight.

Optical Characteristics

Item	Symbol	Condition	Specifications			Unit	Note
			Min.	Typ.	Max.		
Contrast Ratio	K	$\phi = 0^\circ, \phi = 0$	6.0	12.0	—	—	(6)
Viewing Angle	ϕ	$\phi = 0^\circ, K \geq 2.0$	— 10	0	35	deg.	(6)
Surface Brightness	—	$\phi = 0^\circ, \phi = 0$	60	—	100	nt	(6)
Response Time (Rise Time)	T_{on}	$\phi = 0^\circ$ $\phi = 0$	—	250	350	ms	(6)
Response Time (Decay Time)	T_{of}		—	300	400	ms	

Note (6): Refer to Applications Section for the following definitions: (a) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn on/off Time.



Connector Pin Assignment

Pin No.	Signal	Function
1	FGND	Frame Ground
2	GND	Ground
3	V _{DD}	Power Supply (5V)
4	V _{EE}	Power Supply for LCD Drive
5	WR	Data Write
6	RD	Data Read
7	CE	Chip Enable
8	C/D	WR = "L" D/D = "H": Command Wire C/D = "L": Data Write RD = "L" C/D = "H": Status Read C/D = "L": Data Read
9	NC	No connection
10	RESET	Controller Reset
11	D0	Data Input/Output (LSB)
12	D1	Data Input/Output
13	D2	Data Input/Output
14	D3	Data Input/Output
15	D4	Data Input/Output
16	D5	Data Input/Output
17	D6	Data Input/Output
18	D7	Data Input/Output (MSB)
19	FS	Connect to V _{DD} : 6 x 8 font Connect to GND: 8 x 8 font
20	RV	V _{DD} : Black characters GND: White characters

Connector

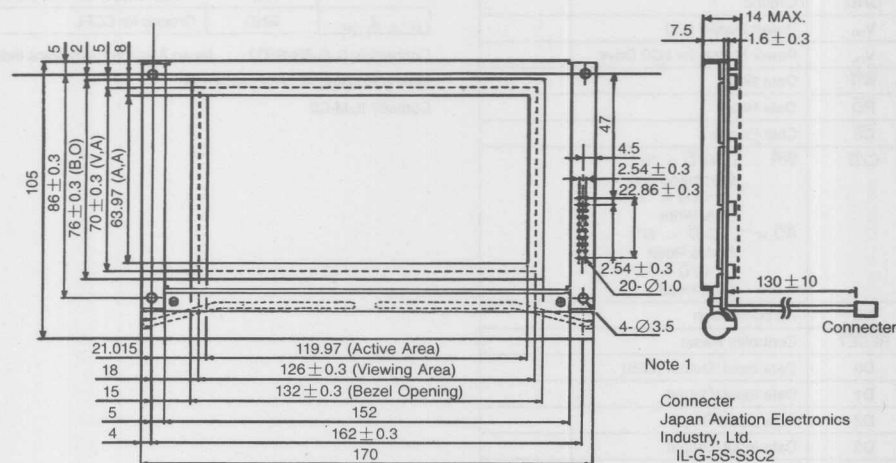
Pin No.	Signal	Function
1	V _{FL}	Power Supply for CCFL Drive
2	GND	Ground for CCFL

Connector: IL-G-5S-S3C2 Japan Aviation Electronics Industry

Mating Housing: IL-M-5P-S3C2-PM

Contact: IL-M-C2

Dimensional Outline



Note 1

Connector
Japan Aviation Electronics
Industry, Ltd.
IL-G-5S-S3C2

Mating Housing
IL-M-5P-S3C2-PM
Contact
IL-M-C2

Power Supply

Recommended Power Supply for LCD Drive

LCD Panel is driven by the voltage $V_{DD} - V_{EE}$, so adjustable V_{EE} is required for contrast control and temperature compensation.

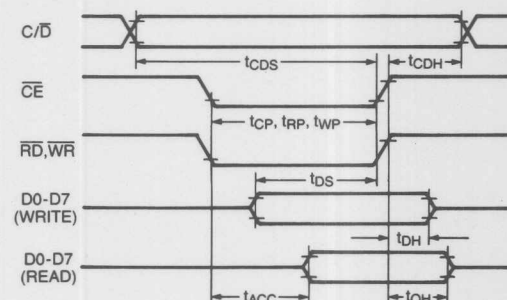
Temperature	0°C	+25°C	+50°C
$V_{DD} - V_{EE}$	20.5	19.0	18.0

Signal Timing

Item	Symbol	Min.	Max.	Unit
C/ \bar{D} Set Up Time	t_{CDS}	100	-	ns
C/ \bar{D} Hold Time	t_{CDH}	10	-	
CE, RD, WR Pulse Width	t_{CP}, t_{RP}, t_{WP}	80	-	
Data Set Up Time	t_{DS}	80	-	
Data Hold Time	t_{DH}	40	-	
Access Time	t_{ACC}	-	150	
Output Hold Time	t_{OH}	10	50	

Conditions: $V_{DD} = 5V \pm 0.25V$, $GND = 0V$, $T_A = 0^\circ C$ to $+50^\circ C$

Bus Timing





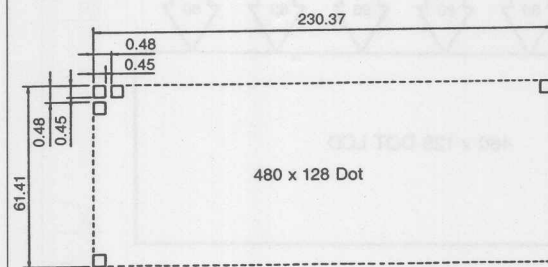
AND1241ST

The AND1241ST is a compact LCD module with 480 x 128 dots graphic display and internal driving circuit. The AND1241ST can display TEXT information, numerals, letters and symbols, as well as GRAPHIC patterns. The AND1241ST is suitable for electronic typewriters/word processors, business machine terminals, and test instruments.

FEATURES

- White mode ST (W-ST: White background).
- 480 x 128 dots graphic display.
- Wide viewing angle and high contrast ratio.
- Simple interface to CPU, direct interface to T7779 (LCD controller).
- Wide operating temperature range (0 to 50°C)

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	275 W x 86 MAX H x 14 MAX D	mm
Number of Dots	480 (Horizontal) x 128 (Vertical)	—
Number of Characters	80 x 16 (1280) Characters (6 x 8 dot format, alpha-numeric)	—
Viewing Area	236 W x 67 H	mm
Bezel Opening	236 W x 67 H	mm
Dot Size	0.45 W x 0.45 H	mm
Dot Pitch	0.48 W x 0.48 H	mm
Weight (Approx.)	280	gram

Absolute Maximum Ratings

Please make sure not to exceed following maximum rating values Under the worst probable conditions.

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	0 to 7	V
	$V_{DD} - V_{EE}$	0 to 29	
Input Voltage	V_{IN}	$GND \leq V_{IN} \leq V_{DD}$	V
Operating Temperature	T_{Op}	0 to 50	°C
Storage Temperature	T_{stg}	-20 to 60	°C
Humidity		10 to 90 (Wet bulb temperature $\leq 29^\circ\text{C}$: no condensation)	%

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Sym- bol	Condition	Min.	Typ.	Max.	Unit	Note
Supply Voltage	V_{DD}		4.75	5.0	5.25	V	
	V_{EE}		-21.0	-20.0	-19.0	V	
Input Voltage	V_{IH}	$V_{DD} = 5V \pm 0.25V$	0.9 V_{DD}	—	V_{DD}	V	
	V_{IL}		0	—	0.1 V_{DD}	V	
Clock Frequency	f_{CL}	$V_{DD} = 5V$ $V_{EE} = -20V$	1.04	1.09	1.14	MHz	
Power Supply Current	I_{DD}	$V_{DD} = 5V$ $V_{EE} = -20V$	—	5.0	8.0	mA	1
	I_{EE}	$f_{CL} = 1.09\text{MHz}$	—	1.7	2.6		

Note 1: All Dots On, $V_O = -14$

Optical Characteristics

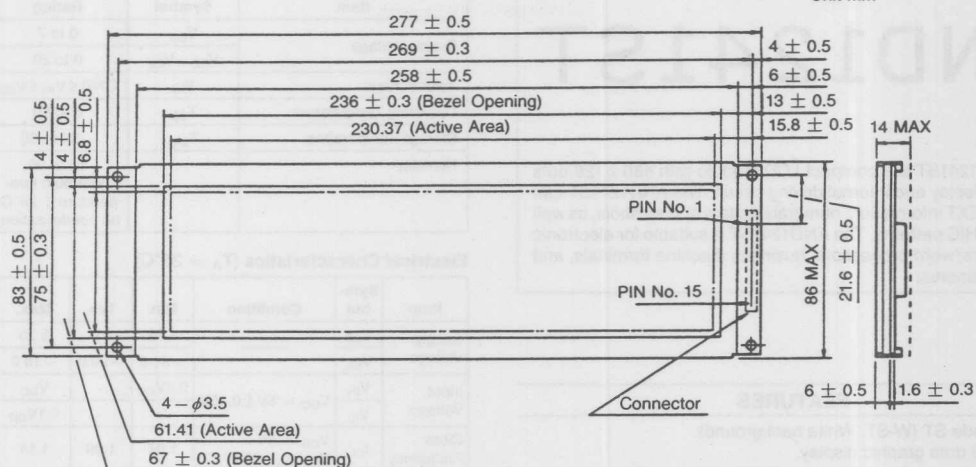
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Viewing Angle	ϕ	$T_A = 25^\circ\text{C}$ $\theta = 0^\circ$ $K \geq 1.3$	-15	—	40	Degree	—
Contrast Ratio	K	$T_A = 25^\circ\text{C}$ $\phi = 0^\circ$ $\theta = 0^\circ$	3.0	4.0	—	—	—
Response Time (Turn ON)	T_{on}	$T_A = 25^\circ\text{C}$ $\phi = 0^\circ$ $\theta = 0^\circ$	—	150	300	ms	—
Response Time (Turn OFF)	T_{off}	$T_A = 25^\circ\text{C}$ $\phi = 0^\circ$ $\theta = 0^\circ$	—	150	300	ms	—

Note: Refer to Applications Section for the following definitions: (a) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

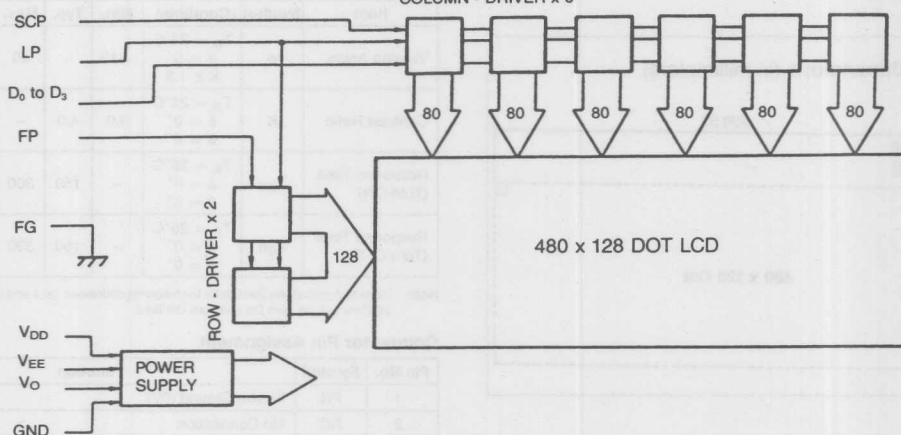
Connector Pin Assignment

Pin No.	Symbol	Function
1	FG	Frame Ground (0V)
2	NC	No Connection
3	FP	Frame Pulse
4	LP	Latch Pulse in one Line
5	SCP	Shift Clock Pulse for column driver
6	GND	Ground (0V)
7	D_0	Data Input
8	D_1	Data Input
9	D_2	Data Input
10	D_3	Data Input
11	GND	Ground (0V)
12	V_{DD}	Power supply (5V)
13	V_O	Power supply for Contrast Control
14	V_{EE}	Power supply for LCD Drive (-20V)
15	GND	Ground (0V)

Unit mm

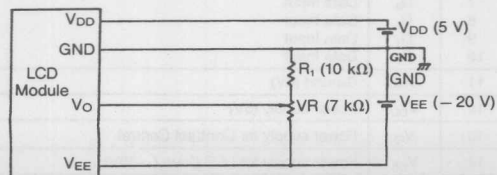


COLUMN - DRIVER x 6



Contrast control power supply V_0 shall be variable in order to control contrast, viewing angle and temperature compensation. Controllable range of V_0 is $V_{EE} \leq V_0 \leq V_{DD} - 8$, and following voltage is recommended at each temperature.

($V_{DD} = 5.0V$, $f_{CL} = 1.09MHz$)

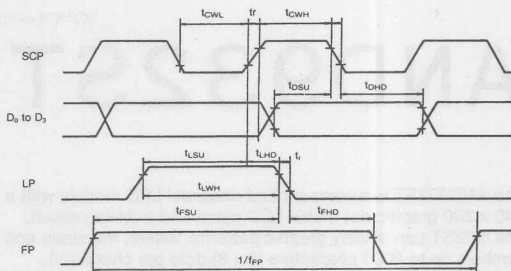


Temperature (0°C)	V ₀ (V) (typical)
0	16.0
25	14.5
50	13.0

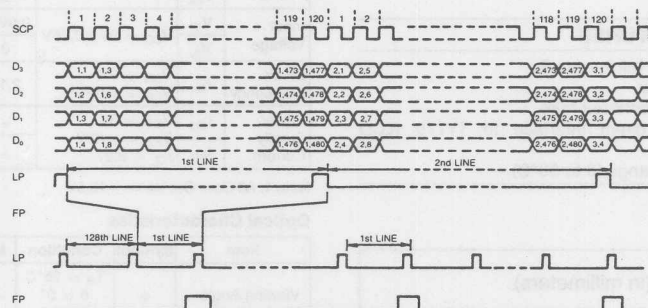
Timing Specification

Item	Symbol	Min.	Typ.	Max.	Unit
CP Pulse Width	t_{CWH}, t_{CWL}	400	430	450	ns
CP Rise/Delay Time	t_r, t_f	—	—	30	ns
Data Set Up Time	t_{DSU}	60	—	—	ns
Data Hold Time	t_{DHD}	30	—	—	ns
LP Set Up Time	t_{LSU}	50	—	—	ns
LP Hold Time	t_{LHD}	105	—	—	ns
LP Pulse Width	t_{LWH}	160	—	—	ns
FP Set Up Time	t_{FSU}	5	—	—	ns
FP Hold Time	t_{FHD}	35	—	—	ns
FR Frequency	f_{FP}	68	71	74	Hz

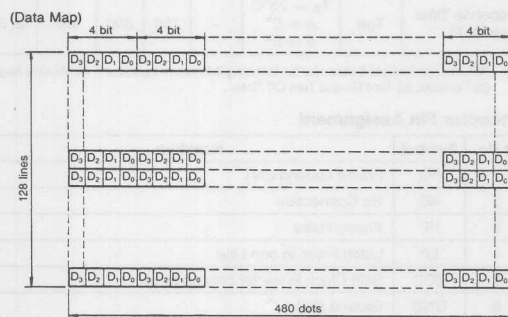
Definition of Timing



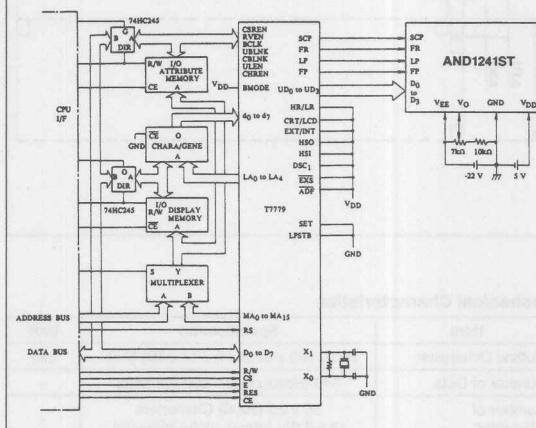
Timing Chart



Data Map



Example of interface





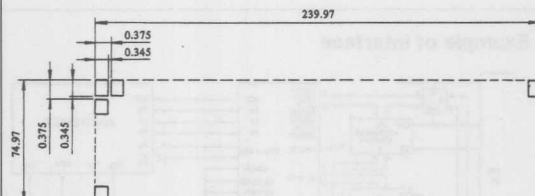
AND932ST

The AND932ST is a compact and universal LCD module with a 640 x 200 graphic dot matrix LCD panel and a driving circuit. AND932ST can display graphic patterns, letters, numerals and symbols up to 2000 characters (8 x 8) dots per character). AND932ST is suitable for personal computers, word processors, POS terminals, business machine terminals and message display of test equipments.

FEATURES

- White mode ST (W-ST: White background).
- 640 x 200 dots graphic display.
- Wide viewing angle and high contrast ratio.
- Simple interface to CPU, direct interface to T7779 (LCD controller).
- Wide operating temperature range (0 to 50°C)

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	293.0 (W) x 97.6 (H) x 14.0 (D) MAX	mm
Number of Dots	640 (Horizontal) x 200 (Vertical)	—
Number of Character	80 x 25 (2000) Characters (8 x 8 dot format, alpha-numeric)	—
Viewing Area	249 (W) x 82 (H)	mm
Bezel Opening	250 (W) x 83 (H)	mm
Dot Size	0.345 (W) x 0.345 (H)	mm
Dot Pitch	0.375 (W) x 0.375 (H)	mm
Weight (Approx.)	360	gram

Absolute Maximum Ratings

Please make sure not to exceed following maximum rating values Under the worst probable conditions.

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	0 to 7	V
	$V_{DD} - V_{EE}$	0 to 29	
Input Voltage	V_{IN}	$GND \leq V_{IN} \leq V_{DD}$	V
Operating Temperature	T_{Op}	0 to 50	°C
Storage Temperature	T_{stg}	-20 to 60	°C
Humidity		10 to 90 (Wet bulb temperature $\leq 29^\circ\text{C}$: no condensation)	%

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Supply Voltage	V_{DD}		4.75	5.0	5.25	V	
	V_{EE}		-22.5	-22.0	-21.5	V	
Input Voltage	V_{IH}	$V_{DD} = 5V \pm 0.25V$	0.9 V_{DD}	—	V_{DD}	V	
	V_{IL}		0	—	0.1 V_{DD}	V	
Clock Frequency	f_{CL}	$V_{DD} = 5V$ $V_{EE} = -22V$	2.18	2.27	2.30	MHz	
Power Supply Current	I_{DD}	$V_{DD} = 5V$ $V_{EE} = -22V$	—	10.0	15.0	mA	1
	I_{EE}	$f_{CL} = 2.27$	—	5.0	10.0		

Note 1: All Dots On, $V_o = -18.5V$

Optical Characteristics

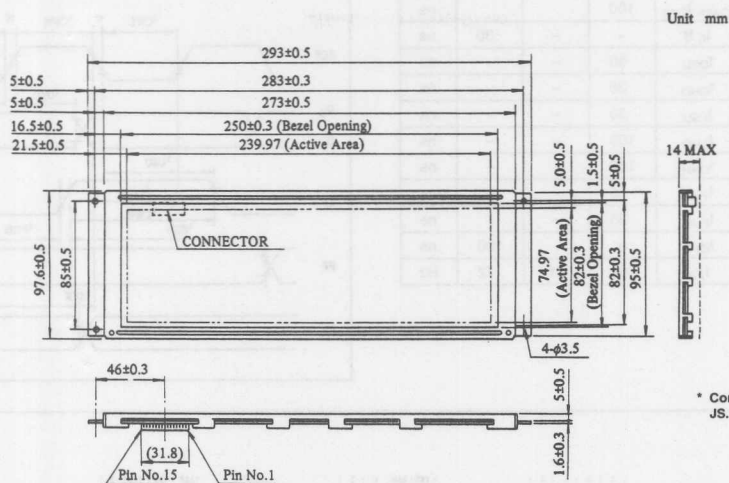
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Viewing Angle	ϕ	$T_A = 25^\circ\text{C}$ $\theta = 0^\circ$ $K \geq 1.3$	-15	—	40	Degree	2, 3
Contrast Ratio	K	$T_A = 25^\circ\text{C}$ $\phi = 0^\circ$ $\theta = 0^\circ$	3.0	4.0	—	—	2, 4
Response Time (Turn ON)	T_{on}	$T_A = 25^\circ\text{C}$ $\phi = 0^\circ$ $\theta = 0^\circ$	—	150	300	ms	2, 5
Response Time (Turn OFF)	T_{off}	$T_A = 25^\circ\text{C}$ $\phi = 0^\circ$ $\theta = 0^\circ$	—	150	300	ms	2, 5

Note: Refer to Applications Section for the following definitions: (a) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

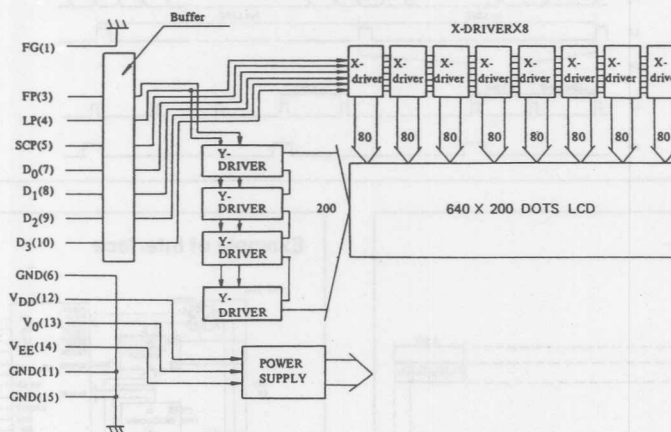
Connector Pin Assignment

Pin No.	Symbol	Function
1	FG	Frame Ground (0V)
2	NC	No Connection
3	FP	Frame Pulse
4	LP	Latch Pulse in one Line
5	SCP	Shift Clock Pulse for column driver
6	GND	Ground (0V)
7	D_0	Data Input
8	D_1	Data Input
9	D_2	Data Input
10	D_3	Data Input
11	GND	Ground (0V)
12	V_{DD}	Power supply (5V)
13	V_O	Power supply for Contrast Control
14	V_{EE}	Power supply for LCD Drive (-22V)
15	GND	Ground (0V)

Dimensional Outline



Block Diagram



Power Supply

Power Supply for contrast control

Contrast control power supply V_0 shall be variable in order to control for contrast, viewing angle and temperature compensation. Controllable range of V_0 is $V_{EE} \leq V_0 \leq V_{DD} - 8$, and following voltage is recommended at each temperature.
($V_{DD} = 5.0V$, $f_{CL} = 2.27MHz$)

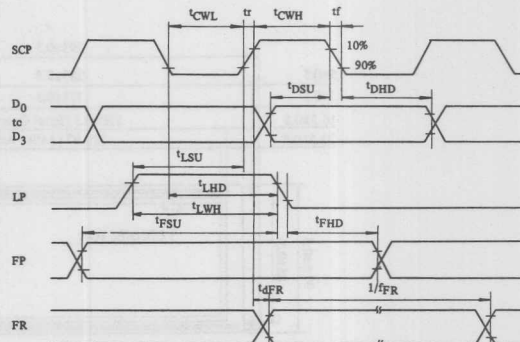
Temperature 0°C	V_0 (V) (typical)
0	-20.5
25	-18.5
50	-16.5



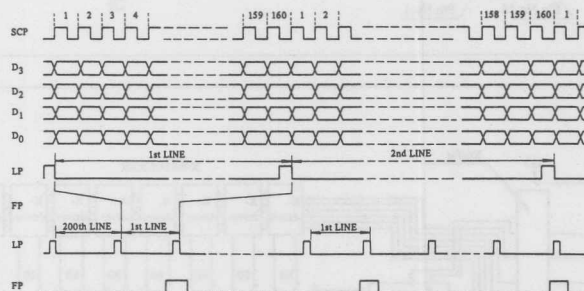
Timing Specification

Item	Symbol	Min.	Typ.	Max.	Unit
SCP Pulser Width	t_{CWL}, t_{CWL}	100			ns
SCP Rise/Delay Time	t_r, t_f	—	—	30	ns
Data Set Up Time	t_{DSU}	60	—	—	ns
Data Hold Time	t_{DHD}	30	—	—	ns
LP Set Up Time	t_{LSU}	50	—	—	ns
LP Hold Time	t_{LHD}	105	—	—	ns
LP Pulse Width	t_{LWH}	160	—	—	ns
FP Set Up Time	t_{FSU}	5	—	—	ns
FP Hold Time	t_{FHD}	35	—	—	ns
FR Delay Time	t_{dFR}	—	—	100	ns
FR Frequency	f_{FR}	68	71	72	Hz

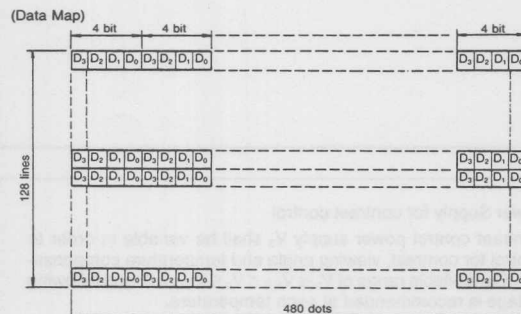
Definition of Timing



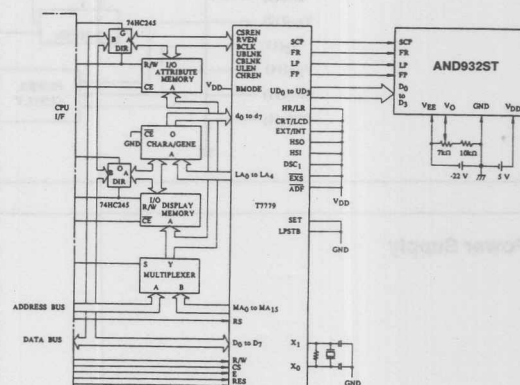
Timing Chart



Data Map



Example of interface



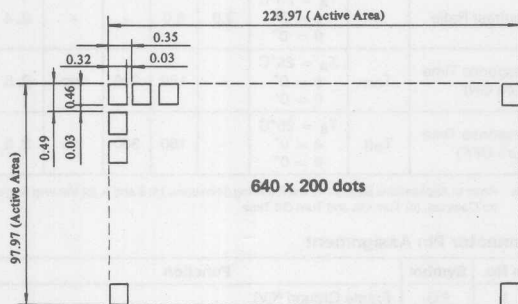
AND561ST

The AND561ST is a compact and universal LCD module with 640 x 200 graphic dot matrix LCD panel and a driving circuit. The AND561ST can display graphic patterns, letters, numerals and symbols up to 2000 characters (8 x 8 dots per character). The AND561ST is suitable for personal computers, word processors, POS terminals, business machine terminals and message display of test equipment.

FEATURES

- White mode ST (W-ST: White background).
- 640 x 200 dots graphic display. (1/200 Duty Drive)
- Wide viewing angle and high contrast ratio.
- Simple interface to CPU, direct interface to T7779 (LCD controller LSI)
- Wide operating temperature range (0 to 50°C)

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	275.0 (W) x 126.0 (H) x 14.0 MAX (D)	mm
Number of Dots	640 (Horizontal) x 200 (Vertical)	—
Number of Character	80 x 25 (2000) Characters (8 x 8 dot format, alpha-numeric)	—
Viewing Area	231.0 (W) x 105.0 (H)	mm
Bezel Opening	232.0 (W) x 106.0 (H)	mm
Dot Size	0.35 (W) x 0.46 (H)	mm
Dot Pitch	0.38 (W) x 0.49 (H)	mm
Weight (Approx.)	500	gram

Absolute Maximum Ratings

Please make sure not to exceed following maximum rating values under the worst probable conditions.

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	0 to 7	V
	$V_{DD} - V_{EE}$	0 to 29	
Input Voltage	V_{IN}	$GND \leq V_{IN} \leq V_{DD}$	V
Operating Temperature	T_{Op}	0 to 50	°C
Storage Temperature	T_{Stg}	-20 to +60	°C

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Supply Voltage	V_{DD}	—	4.75	5.0	5.25	V	
	V_{EE}	—	-22.5	-22.0	-21.5	V	
Input Voltage	V_{IH}	$V_{DD} = 5V \pm 0.25V$	$0.9V_{DD}$	—	V_{DD}	V	
	V_{IL}	—	0	—	$0.1V_{DD}$	V	
Clock Frequency	f_{CL}	$V_{DD} = 5V$ $V_{EE} = -22V$	2.18	2.27	2.30	MHz	
Power Supply Current	I_{DD}	$V_{DD} = 5V$ $V_{EE} = -22V$ $f_{CL} = 2.3\text{MHz}$	—	10.0	25.0	mA	1
	I_{EE}	—	—	5.0	10.0		

Note 1: All Dots On, $V_{O} = -18.5$

Optical Characteristics ($T_{DD} = 5.0V$, $V_{EE} = -13.0V$, $f_{CL} = 2.21\text{MHz}$)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Viewing Angle	ϕ	$T_A = 25^\circ\text{C}$ $\theta = 0^\circ$ $K \geq 1.3$	-15	—	40	Degree	2, 3
Contrast Ratio	K	$T_A = 25^\circ\text{C}$ $\phi = 0^\circ$ $\theta = 0^\circ$	3.0	4.0	—	—	2, 4
Response Time (Turn ON)	T_{on}	$T_A = 25^\circ\text{C}$ $\phi = 0^\circ$ $\theta = 0^\circ$	—	150	300	ms	2, 5
Response Time (Turn OFF)	T_{off}	$T_A = 25^\circ\text{C}$ $\phi = 0^\circ$ $\theta = 0^\circ$	—	150	300	ms	2, 5

Note: Refer to Applications Section for the following definitions: (a) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

Connector Pin Assignment

Pin No.	Symbol	Function
1	FG	Frame Ground (0V)
2	NC	No Connection
3	FP	Frame Pulse
4	LP	Latch Pulse in one line
5	SCP	Shift Clock Pulse for column driver
6	GND	Ground (0V)
7	D_0	Data Input
8	D_1	Data Input
9	D_2	Data Input
10	D_3	Data Input
11	GND	Ground (0V)
12	V_{DD}	Power supply (5V)
13	V_O	Power supply for Contrast Control
14	V_{EE}	Power supply for LCD Drive (-22V)
15	GND	Ground (0V)

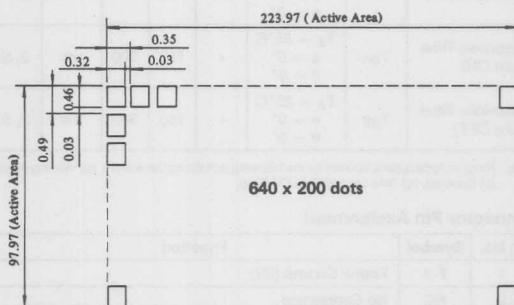
AND1342BST

The AND1342BST is a compact and universal LCD module with 640 x 200 graphic dot matrix LCD panel and a driving circuit. The AND1342BST can display graphic patterns, alphabets, numerals and symbols up to 2000 characters (8 x 8 dots per character). The AND1342BST is suitable for personal computers, word processors, POS terminals, business machine terminals and message display of test equipment.

FEATURES

- Blue mode ST
- 640 x 200 dots graphic display. (1/200 Duty Drive)
- Wide viewing angle and high contrast ratio.
- Simple interface to CPU, direct interface to T7779 (LCD controller LSI)
- Wide operating temperature range (0 to 50°C)
- Transmissive
- Built-in electroluminescent backlight

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	275.0 (W) x 126.0 (H) x 14.0 MAX (D)	mm
Number of Dots	640 (Horizontal) x 200 (Vertical)	—
Number of Character	80 x 25 (2000) Characters (8 x 8 dot format, alpha-numeric)	—
Viewing Area	231.0 (W) x 105.0 (H)	mm
Bezel Opening	232.0 (W) x 106.0(H)	mm
Dot Size	0.35 (W) x 0.46 (H)	mm
Dot Pitch	0.38 (W) x 0.49 (H)	mm
Weight (Approx.)	500	gram

Absolute Maximum Ratings

Please make sure not to exceed following maximum rating values under the worst probable conditions.

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	0 to 7	V
	$V_{DD} - V_{EE}$	0 to 29	
Input Voltage	V_{IN}	$GND \leq V_{IN} \leq V_{DD}$	V
Operating Temperature	T_{op}	0 to 50	°C
Storage Temperature	T_{stg}	-20 to +60	°C

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Supply Voltage	V_{DD}	—	4.75	5.0	5.25	V	
	V_{EE}	—	-22.5	-22.0	-21.5	V	
Input Voltage	V_{IH}	$V_{DD} = 5V \pm 0.25V$	$0.9V_{DD}$	—	V_{DD}	V	
	V_{IL}		0	—	$0.1V_{DD}$	V	
Clock Frequency	f_{CL}	$V_{DD} = 5V$ $V_{EE} = -22V$	2.18	2.27	2.30	MHz	
Power Supply Current	I_{DD}	$V_{DD} = 5V$ $V_{EE} = -22V$	—	10.0	25.0	mA	1
	I_{EE}	$f_{CL} = 2.3\text{MHz}$	—	5.0	10.0		

Note 1: All Dots On, $V_O = -18.5$

Optical Characteristics ($T_{DD} = 5.0V$, $V_{EE} = -13.0V$, $f_{CL} = 2.21\text{MHz}$)

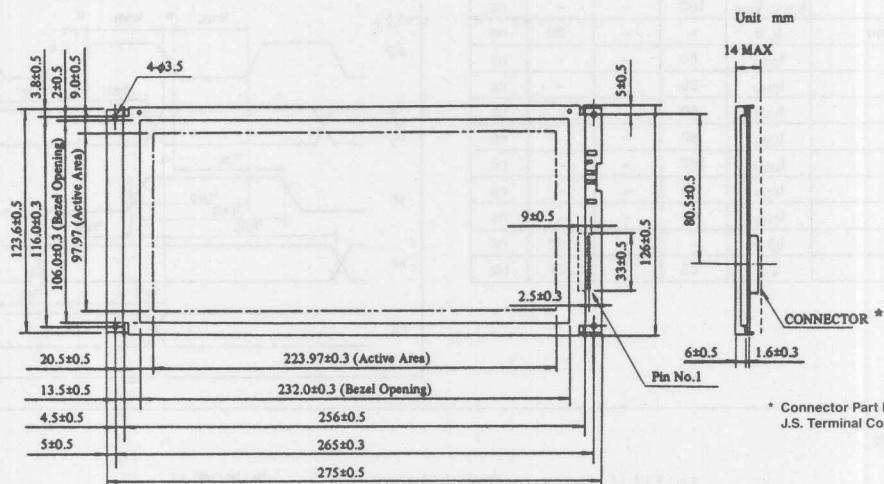
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Viewing Angle	ϕ	$T_A = 25^\circ\text{C}$ $\theta = 0^\circ$ $K \geq 1.3$	-15	—	40	Degree	2, 3
Contrast Ratio	K	$T_A = 25^\circ\text{C}$ $\phi = 0^\circ$ $\theta = 0^\circ$	3.0	6.0	—	—	2, 4
Response Time (Turn ON)	T_{on}	$T_A = 25^\circ\text{C}$ $\phi = 0^\circ$ $\theta = 0^\circ$	—	150	300	ms	2, 5
Response Time (Turn OFF)	T_{off}	$T_A = 25^\circ\text{C}$ $\phi = 0^\circ$ $\theta = 0^\circ$	—	150	300	ms	2, 5

Note: Refer to Applications Section for the following definitions: (a) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn On and Turn Off Time.

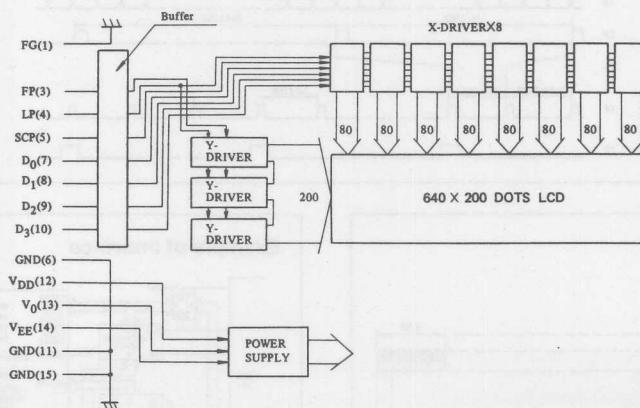
Connector Pin Assignment

Pin No.	Symbol	Function
1	FG	Frame Ground (0V)
2	NC	No Connection
3	FP	Frame Pulse
4	LP	Latch Pulse in one line
5	SCP	Shift Clock Pulse for column driver
6	GND	Ground (0V)
7	D_0	Data Input
8	D_1	Data Input
9	D_2	Data Input
10	D_3	Data Input
11	GND	Ground (0V)
12	V_{DD}	Power supply (5V)
13	V_O	Power supply for Contrast Control
14	V_{EE}	Power supply for LCD Drive (-22V)
15	GND	Ground (0V)

Dimensional outline (in millimeters)



Block Diagram



Power Supply

Power Supply for contrast control

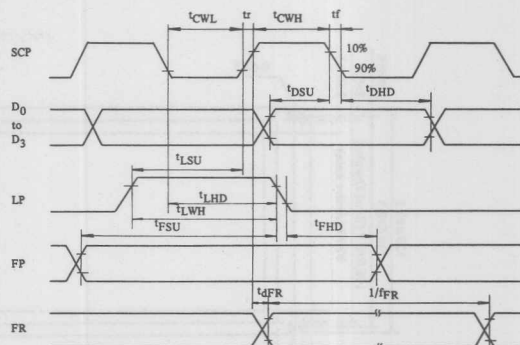
Contrast control power supply V_0 shall be variable in order to control for contrast, viewing angle and temperature compensation. Controllable range of V_0 is $V_{EE} \leq V_0 \leq V_{DD} - 8$, and following voltage is recommendable at each temperature. ($V_{DD} = 5.0V$, $f_{CL} = 2.27MHz$)

Temperature 0°C	V_0 (V) (typical)
0	-20.5
25	-18.5
50	-16.5

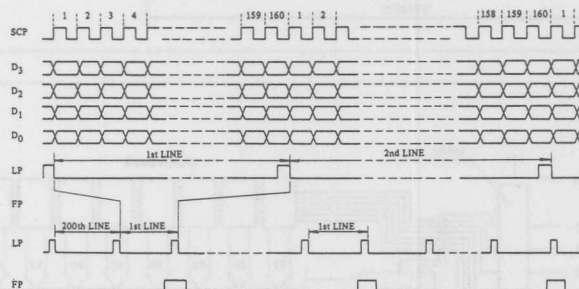
Timing Specifications

Item	Symbol	Min.	Typ.	Max.	Unit
CP Pulse Width	t_{CWH}, t_{CWL}	100	–	–	ns
CP Rise/Delay Time	t_r, t_f	–	–	30	ns
Data Set Up Time	t_{DSU}	60	–	–	ns
Data Hold Time	t_{DHD}	30	–	–	ns
LP Set Up Time	t_{LSU}	50	–	–	ns
LP Hold Time	t_{LHD}	80	–	–	ns
LP Pulse Width	t_{LWH}	160	–	–	ns
FP Set Up Time	t_{FSU}	10	–	–	ns
FP Hold Time	t_{FHD}	60	–	–	ns
FR Delay Time	t_{dFR}	–	–	100	ns
FR Frequency	f_{FR}	68	71	72	Hz

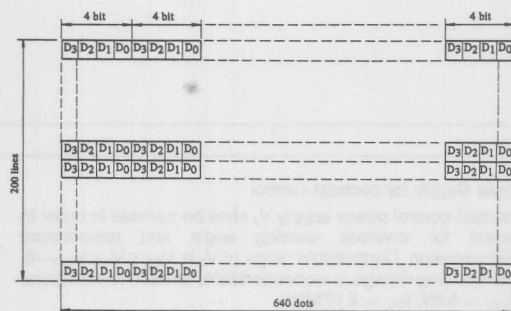
Definition of Timing



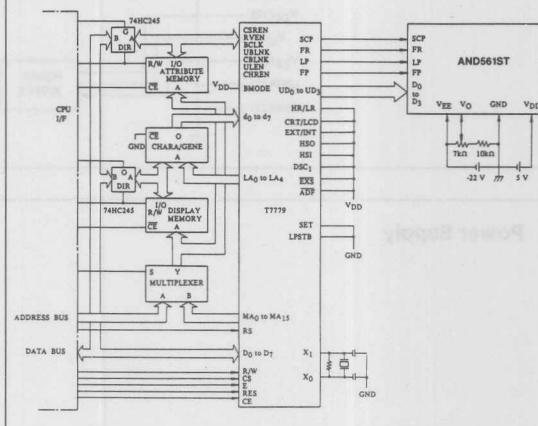
Timing Chart



Data Map



Example of interface



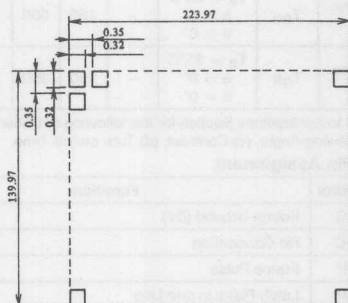
AND1181ST

The AND1181ST is a compact and universal LCD module with a 640 x 400 graphic dot matrix LCD panel and a driving circuit. AND1181ST can display graphic patterns, letters, numerals and symbols up to 4000 characters (8 x 8) dots per character). AND1181ST is suitable for personal computers, word processors, POS terminals, business machine terminals and message display of test equipments.

FEATURES

- White mode ST (W-ST: White background).
- 640 x 400 dots graphic display. (1/200 Duty drive)
- Wide viewing angle and high contrast ratio.
- Simple interface to CPU, direct interface to T7779 (LCD controller LSI)
- Wide operating temperature range (0 to 50°C)

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	276.0 (W) x 168 (H) x 14.0 MAX (D)	mm
Number of Dots	640 (Horizontal) x 400 (Vertical)	—
Number of Character	80 x 50 (4000) Characters (8 x 8 dot format, alpha-numeric)	—
Viewing Area	230 (W) x 148 (H)	mm
Bezel Opening	232 (W) x 148 (H)	mm
Dot Size	0.32 (W) x 0.32 (H)	mm
Dot Pitch	0.35 (W) x 0.35 (H)	mm
Weight (Approx.)	530	gram

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V _{DD}	0 to 7	V
	V _{DD} - V _{EE}	0 to 29	
Input Voltage	V _{IN}	GND ≤ V _{IN} ≤ V _{DD}	V
Operating Temperature	T _{Op}	0 to 50	°C
Storage Temperature	T _{stg}	-20 to 60	°C
Humidity	—	10 to 90 (Wet bulb temperature ≤ 20°C; no condensation)	% RH

Electrical Characteristics (T_A = 25°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Supply Voltage	V _{DD}		4.75	5.0	5.25	V	
	V _{EE}		-23.0	-22.5	-22.0	V	
Input Voltage	V _{IH}	V _{DD} = 5V ± 0.25V	0.9V _{DD}	—	V _{DD}	V	
	V _{IL}		0	—	0.1V _{DD}	V	
Clock Frequency	f _{CL}	V _{DD} = 5V V _{EE} = -22.5V	2.18	2.27	2.30	MHz	
Power Supply Current	I _{DD}	V _{DD} = 5V V _{EE} = -22.5V	—	10.0	15.0	mA	1
	I _{EE}	f _{CL} = 2.27	—	5.0	10.0		

Note 1: All Dots On, V_o = -18.5V

Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Viewing Angle	φ	T _a = 25°C θ = 0° K ≥ 1.3	-15	—	40	Degree	2, 3
Contrast Ratio	K	T _a = 25°C φ = 0° θ = 0°	3.0	4.0	—	—	2, 4
Response Time (Turn ON)	T _{on}	T _a = 25°C φ = 0° θ = 0°	—	150	300	ms	2, 5
Response Time (Turn OFF)	T _{off}	T _a = 25°C φ = 0° θ = 0°	—	150	300	ms	2, 5

Note: Refer to Applications Section for the following definitions: (a) φ and θ, (b) Viewing Angle, (c) Contrast, (d) Turn on/off Time.

Connector Pin Assignment

Pin No.	Symbol	Function
1	FG	Frame Ground (0V)
2	NC	No Connection
3	FP	Frame Pulse
4	LP	Latch Pulse in one Line
5	SCP	Shift Clock Pulse for Column Driver
6	GND	Ground (0V)
7	UD ₀	Upper Screen Data Input
8	UD ₁	Upper Screen Data Input
9	UD ₂	Upper Screen Data Input
10	UD ₃	Upper Screen Data Input
11	GND	Ground (0V)
12	V _{DD}	Power supply (5V)
13	V _O	Power supply for Contrast Control
14	V _{EE}	Power supply for LCD Drive (-22.5V)
15	GND	Ground (0V)
16	LD ₀	Lower Screen Data Input
17	LD ₁	Lower Screen Data Input
18	LD ₂	Lower Screen Data Input
19	LD ₃	Lower Screen Data Input
20	GND	Ground (0V)

Refer to
DATA MAP

Refer to
DATA MAP



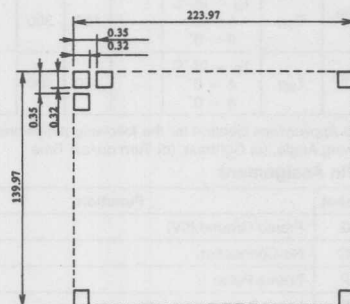
AND1181BST-EO

The AND1181BST-EO is a compact and universal LCD module with a 640 x 400 graphic dot matrix LCD panel and a driving circuit. AND1181BST-EO can display graphic patterns, letters, numerals and symbols up to 4000 characters (8 x 8) dots per character). AND1181BST-EO is suitable for personal computers, word processors, POS terminals, business machine terminals and message display of test equipments.

FEATURES

- Blue mode ST – AND1181BST-EO
- 640 x 400 dots graphic display. (1/200 Duty drive)
- Wide viewing angle and high contrast ratio.
- Simple interface to CPU, direct interface to T7779 (LCD controller LSI)
- Wide operating temperature range (0 to 50°C)
- Transmissive (AND1181BST-EO only)
- Built-in electroluminescent backlight

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	276.0 (W) x 168 (H) x 14.0 MAX (D)	mm
Number of Dots	640 (Horizontal) x 400 (Vertical)	–
Number of Character	80 x 50 (4000) Characters (8 x 8 dot format, alpha-numeric)	–
Viewing Area	230 (W) x 148 (H)	mm
Bezel Opening	232 (W) x 148 (H)	mm
Dot Size	0.32 (W) x 0.32 (H)	mm
Dot Pitch	0.35 (W) x 0.35 (H)	mm
Weight (Approx.)	530	gram

Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	0 to 7	V
	$V_{DD} - V_{EE}$	0 to 29	
Input Voltage	V_{IN}	$GND \leq V_{IN} \leq V_{DD}$	V
Operating Temperature	T_{op}	0 to 50	°C
Storage Temperature	T_{stg}	–20 to 60	°C
Humidity	–	10 to 90 (Wet bulb temperature $\leq 20^\circ\text{C}$: no condensation)	% RH

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Supply Voltage	V_{DD}		4.75	5.0	5.25	V	
	V_{EE}		–23.0	–22.5	–22.0	V	
Input Voltage	V_{IH}	$V_{DD} = 5V \pm 0.25V$	0.9 V_{DD}	–	V_{DD}	V	
	V_{IL}		0	–	0.1 V_{DD}	V	
Clock Frequency	f_{CL}	$V_{DD} = 5V$ $V_{EE} = -22.5V$	2.18	2.27	2.30	MHz	
Power Supply Current	I_{DD}	$V_{DD} = 5V$ $V_{EE} = -22.5V$	–	10.0	15.0	mA	1
	I_{EE}	$f_{CL} = 2.27$	–	5.0	10.0		

Note 1: All Dots On, $V_o = -18.5V$

Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Viewing Angle	ϕ	$T_A = 25^\circ\text{C}$ $\theta = 0^\circ$ $K \geq 1.3$	–15	–	40	Degree	2
Contrast Ratio	K	$T_A = 25^\circ\text{C}$ $\phi = 0^\circ$ $\theta = 0^\circ$	3.0	6.0	–	–	2
Response Time (Turn ON)	T_{on}	$T_A = 25^\circ\text{C}$ $\phi = 0^\circ$ $\theta = 0^\circ$	–	150	300	ms	2
Response Time (Turn OFF)	T_{off}	$T_A = 25^\circ\text{C}$ $\phi = 0^\circ$ $\theta = 0^\circ$	–	150	300	ms	2

Note 2: Refer to Applications Section for the following definitions: (a) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn on/off Time.

Connector Pin Assignment

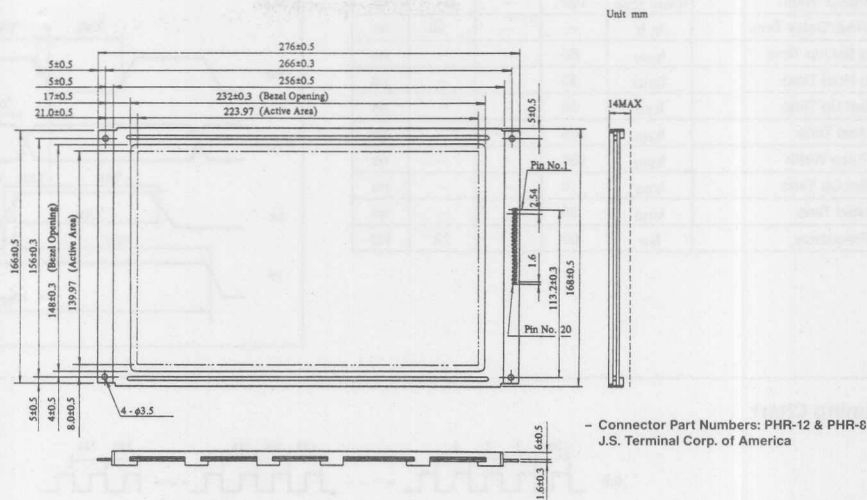
Pin No.	Symbol	Function
1	FG	Frame Ground (0V)
2	NC	No Connection
3	FP	Frame Pulse
4	LP	Latch Pulse in one Line
5	SCP	Shift Clock Pulse for Column Driver
6	GND	Ground (0V)
7	UD_0	Upper Screen Data Input
8	UD_1	Upper Screen Data Input
9	UD_2	Upper Screen Data Input
10	UD_3	Upper Screen Data Input
11	GND	Ground (0V)
12	V_{DD}	Power supply (5V)
13	V_O	Power supply for Contrast Control
14	V_{EE}	Power supply for LCD Drive (–22.5V)
15	GND	Ground (0V)
16	LD_0	Lower Screen Data Input
17	LD_1	Lower Screen Data Input
18	LD_2	Lower Screen Data Input
19	LD_3	Lower Screen Data Input
20	GND	Ground (0V)

Refer to DATA MAP

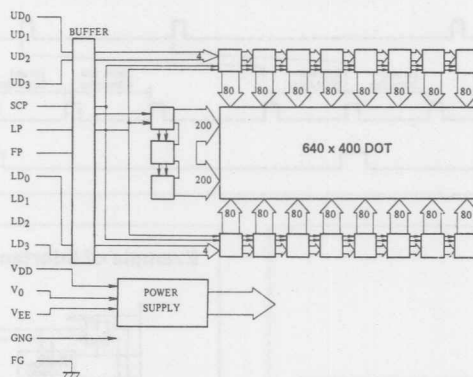
Refer to DATA MAP



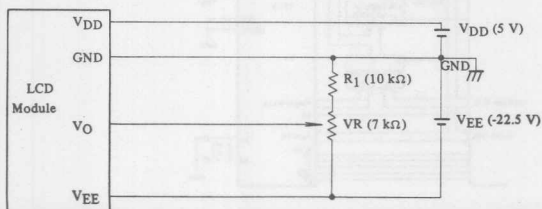
Dimensional Outline



Block Diagram



Power supply for contrast control



Contrast control power supply V_0 shall be variable in order to control for contrast, viewing angle and temperature compensation. AND1181ST/AND1181BST-EO have control range of $V_{EE} \leq V_0 \leq V_{DD} - 8$, and following voltage is recommended at each temperature.
($V_{DD} = 5.0V$, $f_{CL} = 2.27MHz$)

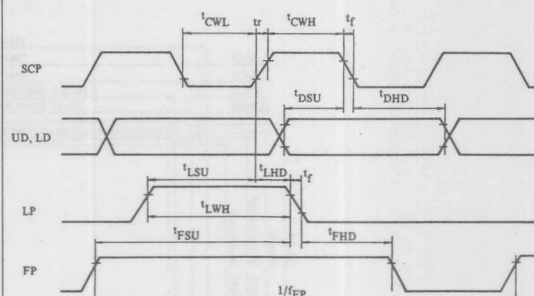
Temperature 0°C	V_0 (V) (typical)
0	-20.5
25	-18.5
50	-16.5



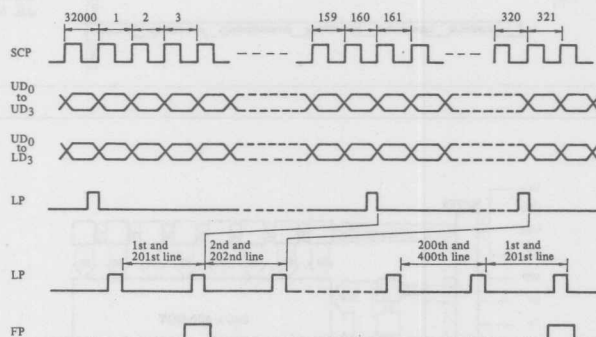
Timing Specifications

Item	Symbol	Min.	Typ.	Max.	Unit
CP Pulser Width	t_{CWH}, t_{CWL}	100	—	—	ns
CP Rise/Delay Time	t_r, t_f	—	—	30	ns
Data Set Up Time	t_{DSU}	60	—	—	ns
Data Hold Time	t_{DHD}	30	—	—	ns
LP Set Up Time	t_{LSU}	50	—	—	ns
LP Hold Time	t_{LHD}	105	—	—	ns
LP Pulse Width	t_{LWH}	160	—	—	ns
FP Set Up Time	t_{FSU}	5	—	—	ns
FP Hold Time	t_{FHD}	35	—	—	ns
FP Frequency	f_{FP}	68	71	72	Hz

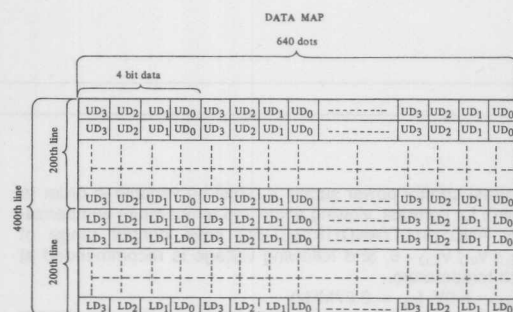
Definition of Timing



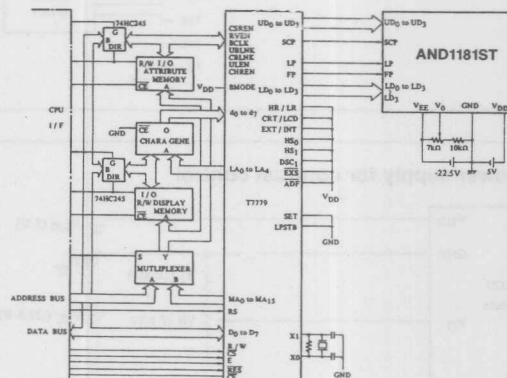
Timing Chart



Data Map



Example of interface





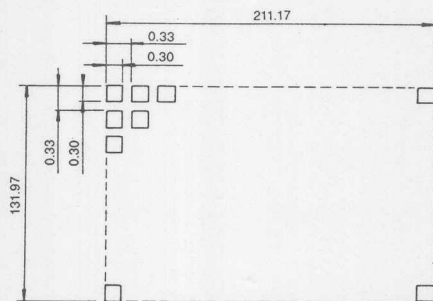
AND1501MST

The AND1501MST is a compact and universal LCD module with a 640 x 400 graphic dot matrix LCD panel and a driving circuit. AND1501MST can display graphic patterns, alphabets, numerals and symbols up to 4000 characters (8 x 8 dots per character). AND1501MST is suitable for personal computers, word processors, POS terminals, business machine terminals and message display of test equipments.

FEATURES

- Black and white ST (M-ST) transmissive mode.
- Built-in CCFL backlight.
- 640 x 400 dots graphic display. (1 / 200 Duty drive)
- Wide viewing angle and high contrast ratio.
- Simple interface to CPU, direct interface to T7779 (LCD controller LSI)
- Wide operating temperature range (0 to 50°C)

Dot Matrix Dimensions (in millimeters)



Mechanical Characteristics

Item	Specification	Unit
Outline Dimension	320 (W) x 197.4 (H) x 22 (D) MAX.	mm
Number of Dots	640 x 400 DOTS	-
Bezel Opening	219 (W) x 140 (H)	-
Viewing Area	217.2 (W) x 138.0 (H)	mm
Active Area	211.17 (W) x 131.97 (H)	mm
Dot Size	0.30 (W) x 0.30 (H)	mm
Dot Pitch	0.33 (W) x 0.33 (H)	mm
Weight (Approx.)	700	gram

Absolute Maximum Ratings

Item	Symbol	Absolute Maximum Ratings		Unit
		Min.	Max.	
Supply Voltage	V_{DD}	0	7.0	V
	$V_{DD} - V_e$	0	30	
	V_{FL}	-	3.0	KVrms
CCFL Input Current	I_{FL}	-	15	mA rms
CCFL Drive Frequency	f_{FL}	-	60	kHz
Input Voltage	V_{IN}	GND - 0.5	$V_{DD} + 0.5$	V
Storage Temperature	T_{stg}	-20	60	°C
Operating Temperature	T_{op}	0	50	°C
Humidity Note (1)	-	10	90	% RH

Note (1) Wet bulb temperature ≤ 29 deg. C, no condensation of water.

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

Item	Symbol	Condition	Specifications			Unit	Note
			Min.	Typ.	Max.		
Supply Voltage	V_{DD}	$T_A = 25^\circ\text{C}$	4.75	5.0	5.25	V	
	V_e		-19.5	-15.7	-12.4	V	
	V_{FL}		300	-	700	V rms	
CCFL Start Voltage	V_S		-	-	900	V rms	
CCFL Drive Frequency	f_{FL}	$T_A = 25^\circ\text{C}$	20	-	45	kHz	(2)
Input Voltage	(H level) V_{IH}	$V_{DD} = 5.0V$	$V_{DD} - 0.5$	5.0	$V_{DD} + 0.3$	V	
	(L level) V_{IL}		-0.3	0	0.5	V	
Frame Frequency	f_{FP}		60	-	80	Hz	
Current Consumption 1	I_{DD}	$V_{DD} = 5.0V$	-	8.8	13.5	mA	(3)
	I_e	$V_e = 15.7V$ $f_{FP} = 72\text{Hz}$	-	4.8	7.0	mA	
Current Consumption 2	I_{DD}	$V_{DD} = 5.0V$	-	16.5	25.0	mA	(4)
	I_e	$V_e = 15.7V$ $f_{FP} = 72\text{Hz}$	-	12.5	19.0	mA	
CCFL Input Current	I_{FL}	$f_{FL} = 30\text{kHz}$	-	5x2	10x2	mA rms	(5)

Note (2) FL drive frequency should be decided in order to prevent flickering with the frame frequency of LCD.

(3) For typical case (all text).

(4) For maximum case (every other "ON" line).

(5) Life time of backlight will decrease according to the input current of CCFL backlight.

Optical Characteristics

Item	Symbol	Condition	Specifications				Note
			Min.	Typ.	Max.	Unit	
Contrast Ratio	K	$\theta = 0^\circ, \phi = 0$	6.0	12.0	-	-	(6)
Viewing Angle	ϕ	$\theta = 0^\circ, K \geq 2.0$	-10	0	35	deg.	(6)
Surface Brightness	-	$\theta = 0^\circ, \phi = 0$	60	-	100	nt	(6)
Response Time (Rise Time)	T_{on}	$\theta = 0^\circ$ $\phi = 0$	-	250	350	ms	(6)
Response Time (Decay Time)	T_{off}		-	300	400	ms	

Note (6): Refer to Applications Section for the following definitions: (a) ϕ and θ , (b) Viewing Angle, (c) Contrast, (d) Turn on/off Time.



Interface cable

Pin No.	Signal	Function
1	FP	Frame Pulse
2	LP	Latch Pulse in one Line
3	SCP	Shift Clock Pulse for Column Driver
4	NC	No connection
5	NC	No connection
6	V _{DD}	Power Supply (5V)
7	GND	Ground
8	V _e	Power Supply for LCD Drive
9	UD ₀	Upper Screen Data Input
10	UD ₁	Upper Screen Data Input
11	UD ₂	Upper Screen Data Input
12	UD ₃	Upper Screen Data Input
13	LD ₀	Lower Screen Data Input
14	LD ₁	Lower Screen Data Input
15	LD ₂	Lower Screen Data Input
16	LD ₃	Lower Screen Data Input

Interface Cable: SMCD-16(P1.25) Sumitomo Electrical Industries, Ltd.
Mating Connector: ZC-016 (Straight Type)
ZC-116 (Right Angle Type)

Connector 1

Pin No.	Signal	Function
1	V _{FL}	Power Supply for CCFL Drive (Upper CCFL)
2	V _{FL}	Power Supply for CCFL Drive (Lower CCFL)
3	NC	No Connection

Connector: S3B-EH Japan Solderless Terminal Corp. Ltd.
Mating Connector: EHR-3

Connector 2

Pin No.	Signal	Function
1	NC	No Connection
2	GND	Ground for CCFL

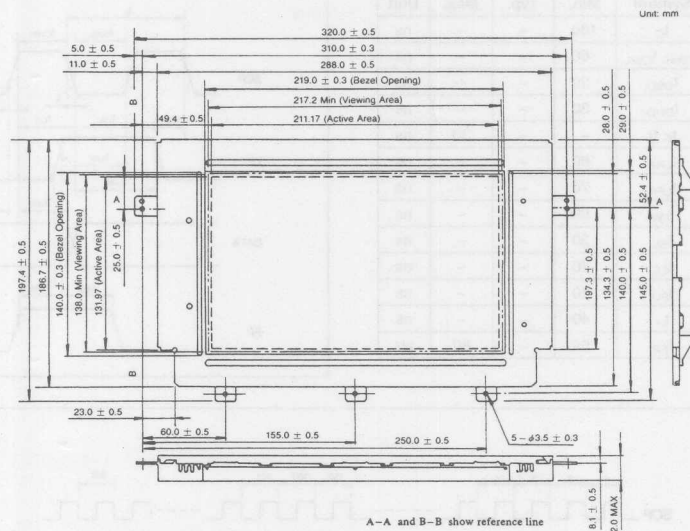
Connector: S2B-EH Japan Solderless Terminal Corp. Ltd.
Mating Connector: EHR-2

Sumitomo Electric U.S.A., Inc.
J.S.T. CORPORATION

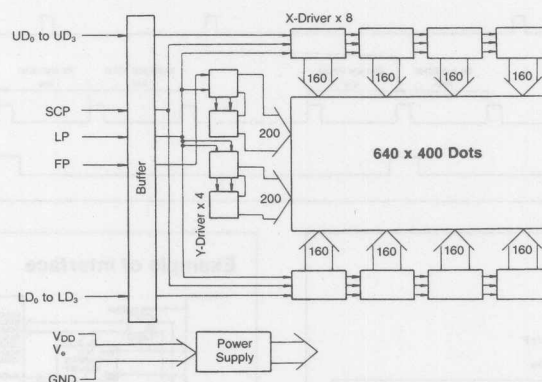
(212) 308-6444
(312) 803-3300



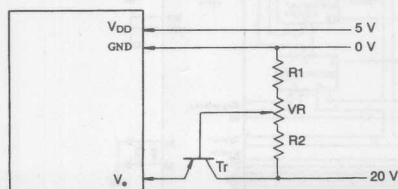
Dimensional Outline



Block Diagram



Power supply for contrast control



Contrast control power supply V_e shall be variable in order to control for contrast, viewing angle and temperature compensation. Controllable range of V_e shall be $-23.5V \leq V_e \leq V_{DD} - 8$. Following voltage is recommended at each temperature.

Temperature (Deg. C)	$V_e(V)$ (Typical)	Condition
0	-17.7	$V_{DD} = 5V$ $f_{FP} = 72Hz$
25	= 15.7	
50	= 13.7	

Product Description

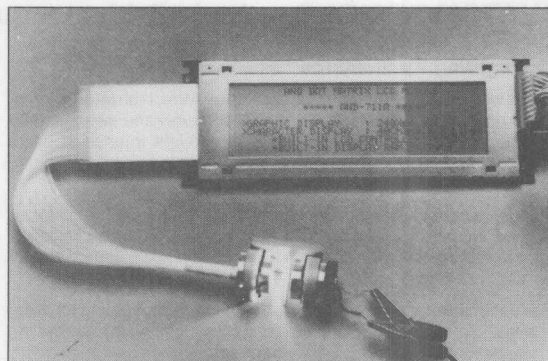
AND's Fiber Optic Backlight is a light-emitting panel woven from acrylic optical fibers. Computer-controlled "micro-bends" cause the transmitted light to exceed the critical angle of the fiber's core-cladding interface. This allows the light to leave the fiber without physically interrupting the cladding surface. The panel is woven so the maximum amount of light possible is emitted along the entire panel surface. The translucent monofilament weft aids in diffusing the light. The result is uniform light at intensities 10 to 100 times greater than standard EL lamps.

The panel is connected to a remote light source by either a cable or ribbon of optical fibers.

Our standard light source is 2.5W at 5V DC. However, a variety of custom light sources are also available. These light sources range from a 20mA, 4V DC LED lamp to a 75W, 12V lamp. All IR and UV energy is filtered out at the source. Any visible frequency may be obtained through the use of filters. The light source housing is easily detachable from the cable, and the lamp is easily replaced in a matter of minutes.

Features

- Usable in virtually any application requiring a high intensity backlight
- Usable in either AND or competing LCDs, both LCD dot matrix modules and panel displays. Increases readability.
- VERY BRIGHT — 45 – 120 Ft-L with 2.5W source
- Bulb life — 5,000 hrs at 5 VDC
40,000 hrs at 4 VDC
Intensity is variable
Lamp is easily replaceable
- Life of panel is unlimited
- No heat — EMI – RMI at illuminated area
- Highly shock resistant
- Upper temperature limit +80°C
- Panel can be used under water
- Color easily changed through multiple sources or changeable filters
- Available light sources
 - 2.5W, 5 VDC halogen lamp (standard source)
 - 4.85W, 5 VDC halogen lamp
 - 4.22W, 4.5 VDC halogen lamp
 - 20mA, 3.5 VDC LED lamp
 - 75W, 12 VDC lamp



Technical Data

Fiber Core Material	Polymethy Methacrylate
Fiber Cladding	Fluoropolymer
Weft	Monofilament
Power Requirements	2.5 Watts at 5 VDC
Lamp Rated Life	5000 Hours at Rated Power
Maximum Cable Length	10 Feet
Temperature Range	-50°C to +80°C

Standard LCD Backlight

Fiber Optic Backlight P/N	Use with AND LCD P/N	Approximate Dimensions (A x B) in mm
BL591	AND591-30	166.0 x 22.0
BL721	AND721-30	97.0 x 31.8
BL771	AND771-30	104.5 x 21.0
BL771-LED	AND771-30	104.5 x 21.0
BL711	AND711A-30	162.5 x 44.3
BL1021	AND1021-30	76.8 x 50
BL1013	AND1013-30	109.5 x 87.2
BL1181	AND1181ST-30	266.0 x 148.0
BL1301	AND1301VST-30	209.3 x 105.5
BL561	AND561ST-30	265.0 x 106.0
BL1391	AND1391ST-30	64.0 x 64.0



CUSTOM DESIGNS — for individual requirements

Backlighting Applications

AND's woven optical fiber panels provide uniform, high intensity light which enhances the readability of LCD's, membrane switches and other instrumentation display applications. Light intensities up to several thousand foot lamberts are available, providing backlighting for even the most complex color graphic displays.

Any application requiring uniformity, easy maintenance, high intensity, color, motion or intensity control, thinness, coolness, flexibility, ruggedness, moisture resistance or safety, is a good application for the AND backlight.

Applications include but are not limited to: courtesy lighting for automobiles, aircraft, trucks and boats; accent lighting for swimming pools and hot tubs; transparency backlighting for signs or directory boards; special effects lighting for amusement rides, rock bands, bars and stage shows; liquid level indicators; plant growth chambers; underwater seaweed farms and works of art.

Backlighting Comparison

What Makes This Panel Different From An EL?

Electroluminescent lamps are limited in the brightness they can provide. Typically they offer from 7 to 14 foot-lamberts. Higher output is possible by driving them at a higher frequency, however this usually shortens life drastically. EL has a normal life of 1000 hours before its output is reduced to one-half. The "half life" can be increased, but normally at the cost of reduced initial brightness.

EL is susceptible to high humidity which causes the lamp to delaminate. Brightness can't be controlled through as full a range as the AND panel. There is a threshold frequency required to excite the phosphors. Color can't be changed in an EL without replacing the lamp itself. Finally, the entire EL has to be replaced when it burns out—often necessitating the disassembly of the LCD.

The AND panel can be as bright as you like. Normal brightness using an acceptable power draw is from 3 to 10 times greater than EL. Normal life is 5000 hours with no reduction of intensity. Panel color can be easily changed by using 2 filtered light sources, or by using a color wheel or slide. The halogen incandescent lamp is fully controllable from full off to about 150% of rated voltage.

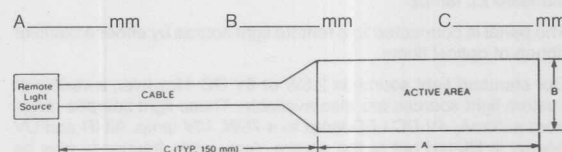
The AND panel is impervious to moisture. The panel is totally passive—emitting no heat, EMI or RMI. The panel never needs to be replaced, only the lamp and possibly the reflector. This takes only a few minutes.

Finally, because the weaving process is fairly simple, it is possible to make almost any size of backlight, without expensive tooling costs.

Custom Backlight Information

AND encourages inquiries for custom backlighting application. Please consider the following parameters and complete the attached form or write or FAX to AND describing your requirements.

Backlight Maximum Dimensions



LCD Viewing Area

H _____ mm

W _____ mm

Maximum Power-Voltage

P _____ Watts

V _____ Volts

Maximum Backlight Thickness

_____ mm

Quantity

What Makes The AND Backlight Different From Cold Cathode?

Cold Cathode backlighting is very bright. However, it must be used with a rather large reflector and a heavy diffuser. The AND panel can provide almost the same brightness with only 1/4th the depth. If you are willing to add one or two layers, we can usually provide the same brightness.

Cold Cathode requires a lot of "noise-producing" electronics to convert the DC to high frequency AC. AND panels are passive and do not have "noise" to worry about.

Cold Cathode lamps suffer a darkening at either end, sometimes after only 1000 hours of use. You can design around this by lengthening the tubes and their housing, so the dark areas don't happen behind the display. This costs space and money. AND panels do not darken. The backlighting assembly needs to be only as big as the display.

Cold Cathode lamps are fragile. AND panels on the other hand are not. The halogen lamp is rated at 32 G's and the panel itself will not break.

Like and EL, the intensity of cold cathode is not fully controllable and its color can't be easily changed. The AND panel is and can be!

The cost of an AND panel and light source are usually close to the cost of the entire lamp-reflector-diffuser-housing assembly required for cold cathode backlighting.



Pulse Drive of LED Lamps	5-2
Field Effect LCD Interconnect Techniques	5-4
Field Effect LCD Driver Application Note	5-7
Character LCD Modules Interface Data	5-19
Medium Size Graphic LCD Interface Application Data	5-34
Optical Definitions	5-48
Installation Caution and Handling Precaution	5-48
Vendor Sources	5-49



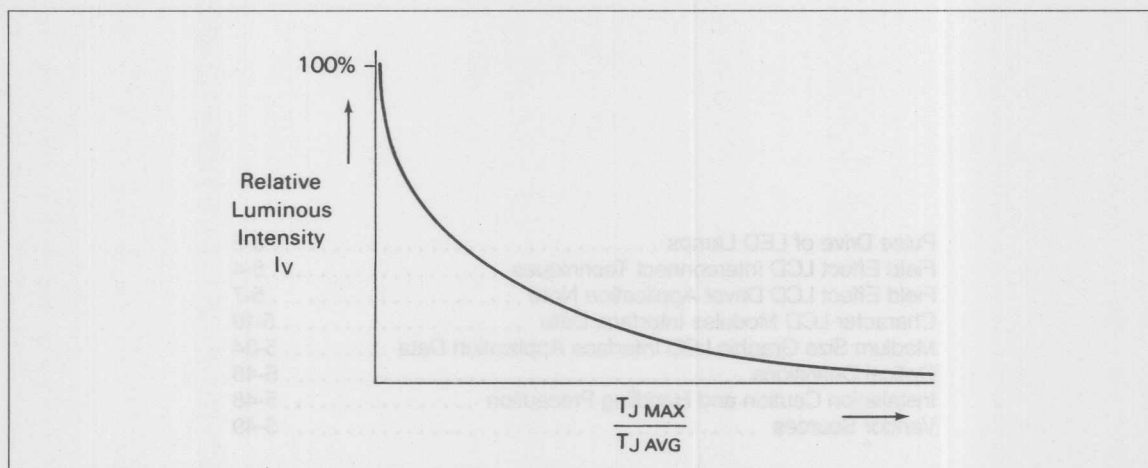
When operating a LED lamp in a pulse mode, it is the maximum junction temperature (not the average) that governs the performance of the device as to the allowed pulse time, average power dissipation and light output. The lower the maximum junction temperature

($T_{J \text{ MAX}}$) is in relation to the average junction temperature ($T_{J \text{ AVG}}$), the greater is the light output of the device (as shown below).

At slow refresh rates (the number of times per second a lamp is pulsed) in the range of 100 Hz, the $T_{J \text{ MAX}}$, $T_{J \text{ AVG}}$ ratio is very big. As

the refresh rate approaches 1000 Hz this ratio drops down to nearly 1 (it will never reach 1). Therefore, it is recommended whenever possible to refresh LED lamps at a refresh rate of 1 kHz or faster, since at these faster pulses $T_{J \text{ MAX}}$ is to be equal to $T_{J \text{ AVG}}$ and the light output is a function of the average junction temperature.

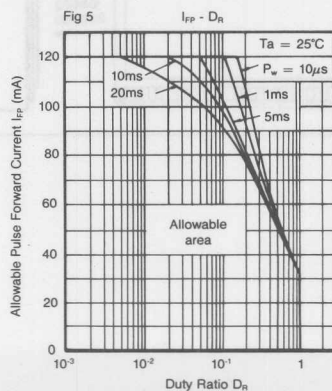
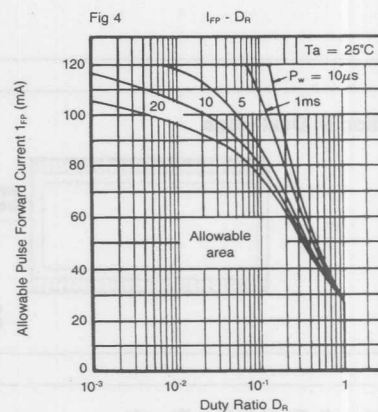
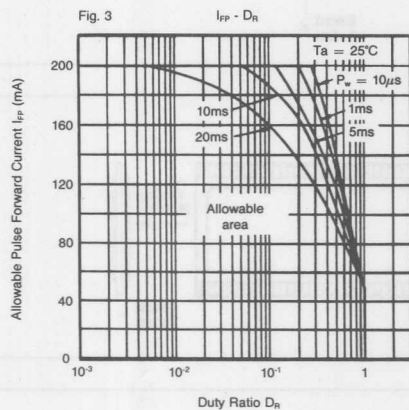
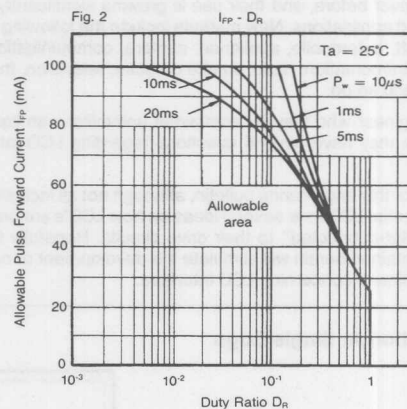
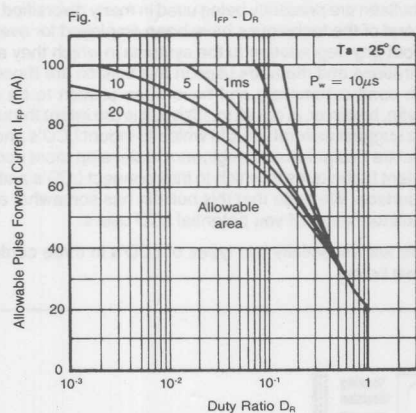
For the appropriate maximum allowable pulse forward current versus duty cycle or pulse width see Table and appropriate figures on the following pages.



Allowable Pulse Forward Current Ratings ($T_A = 25^\circ\text{C}$)

Type	$I_F (\text{MAX})$ (mA)	Allowable Pulse Forward Current $I_{FP \text{ MAX}}$ (mA)	Figure No.
Standard Bright GaP - red	20	100	1
	25		2
Kilo Bright Ga Al As - red	50	200	3
All Others	25	120	4
	30		5

Note: Pulse Width $P_W = 100\mu\text{s}$
Duty Ratio $D_R = 10:1$



Liquid crystal displays (LCD's) are enjoying more and more popularity today than ever before, and their use is growing significantly in many diversified applications. New markets include the following industries: aircraft, automobile, appliance, camera, communications equipment, instrumentation, radio, smoke detector, television, thermostat, scale and so on.

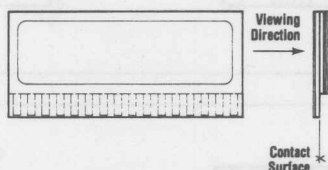
The design engineer who may be somewhat unfamiliar with liquid crystal displays may have several questions regarding LCD interface.

It is the object of this engineering bulletin, although not all inclusive, to give the potential LCD user several ideas on how LCD's are presently being "inter-connected" to their drive circuits. Hopefully the information contained herein will stimulate the development of new methods/techniques concerning LCD interface.

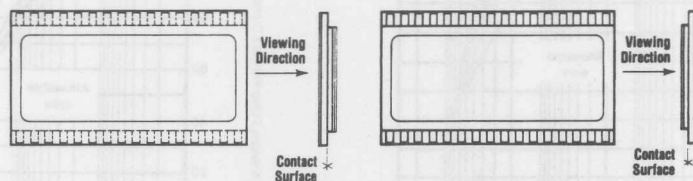
The LCD connector/interface techniques illustrated in this engineering bulletin are presently being used in many diversified applications. Several of the techniques have been employed for over many years without any degradation to the systems in which they are used. The illustrations and methods used in this bulletin are those which have been used extensively and have been proven to be reliable. This bulletin, however, is not all inclusive. It is the intent through this bulletin to suggest several ways in which to mount LCD's and to hopefully stimulate designers and engineers to develop more economical and efficient techniques in which to interconnect LCD's and their mounting surface. We hope that this bulletin has somewhat educated and stimulated some of you potential LCD users.

There are essentially two types of LCD's in three configurations as shown below.

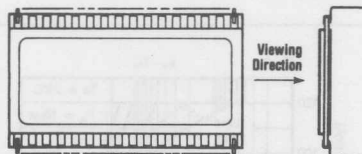
Configuration A: Single Edge



Configuration B: Dual Edge



Configuration C: Dual Edge, Plug-in



Interconnects

Single Edged LCD's (Configuration A)

There are basically three ways in which to connect the single edge LCD:

Method 1: This method features the use of the 90° LCD connector in which a conductive elastomer strip or similar conductive elastomeric interconnect medium is used. The illustration shows a 90° LCD connector assembly. This assembly was designed to edge mount LCD's to printed circuit boards. The connector consists of a holder secured to the PC board with two screws and a metal clip that holds the elastomer strip and the LCD in contact. Two pilot holes ensure the alignment of the PC board circuit path and the LCD.

FEATURES

- No soldering
- Rapid assembly/dis-assembly
- Elimination of lead spring and positioning
- Minimization of space
- Shock and vibration protection
- Non-abrasive contact pads

Method 2: Method 2 features a single edge plug-in connector as illustrated. This connector is soldered permanently into place upon its base. One then simply inserts and/or removes the LCD as required.

FEATURES

- Highly conductive, corrosion free contacts
- Self-alignment of LCD
- Rigid mechanical support
- Rugged, plastic housing
- Shock and vibration resistance
- Rapid assembly

Method 3: This method features a "single-in-line connector" which utilizes a conductive elastomer strip, and allows one to mount the LCD parallel to the substrate. The example illustrates the Tecknit Single In-Line Connector Assembly:

FEATURES

- No soldering
- Rapid assembly
- Space saving
- Self-alignment
- Shock and vibration resistance
- Non-abrasive contact pads

Figure 5

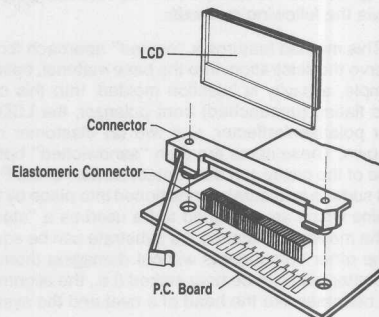


Figure 6

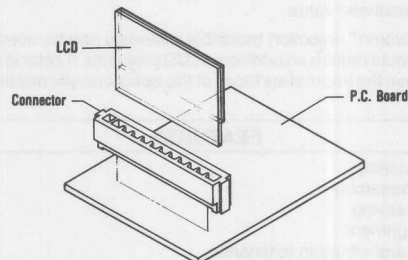
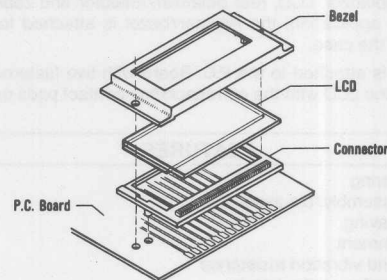


Figure 7



Dual Edged LCD's (Configuration B)

Dual edged (pinless or leadless) LCD's can be mounted and interconnected via the following methods:

Method 1: This method features a "nested" approach for interconnects. Observe the illustration. Into the base material, optical acrylic in this example, a cavity is injection molded. Into this cavity one drops a free flating (unattached) front polarizer, the LCD, the free floating rear polarizer/reflector, and two (2) elastomer connector strips as shown. These items are then "sandwiched" between the inner surface of the cavity and the contact surface of the P.C. board. The contact surface is accurately positioned into place by the use of alignment pins which are designed to be used as a "stand-off" to determine the maximum distance the substrate can be squeezed to sandwich the other components without damaging them. Once in place, the locator pins can be heat staked (i.e., the alignment/locator pin then becomes like the head of a rivet and the system is assembled.

Optical acrylic was used in this example because:

- It can be injection molded
- Of its optical properties (eliminating the need for an additional part—the optical protector to be placed over the LCD)
- Of its aesthetic value

Other "colored", injection moldable materials can be used but this system would require an additional LCD protector. If color is required, simply have the internal surfaces of the optical acrylic material painted.

FEATURES

- No soldering
- Rapid assembly
- Space saving
- Self-alignment
- Shock and vibration resistance
- Non-abrasive contact pads
- Assembled, protected and cased unit

Method 2: This method features the Tecknit "Dual Edged In-Line Connector Assembly" as illustrated. This method also sandwiches the front polarizer, LCD, rear polarizer/reflector and zebra[®] strips, but in this application, the retainer/bezel is attached to the P.C. board, not the case.

The bezel is attached to the P.C. Board with two fasteners which also align the LCD with the corresponding contact pads on the P.C. board.

FEATURES

- No soldering
- Rapid assembly/dis-assembly
- Space saving
- Self-alignment
- Shock and vibration resistance
- Non-abrasive contact pads

Connector Pinned LCD's (Configuration C)

Almost self-explanatory, the LCD with connector pins is simply inserted into the plug-in sockets as shown below:

FEATURES

- Self-alignment of LCD
- Highly conductive, corrosion free contacts
- Rigid mechanical support
- Rapid assembly
- Shock and vibration resistance

Figure 8

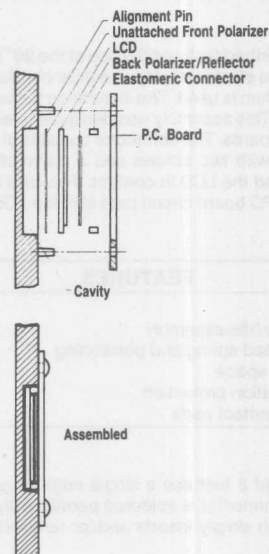


Figure 9

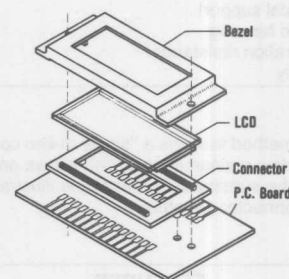
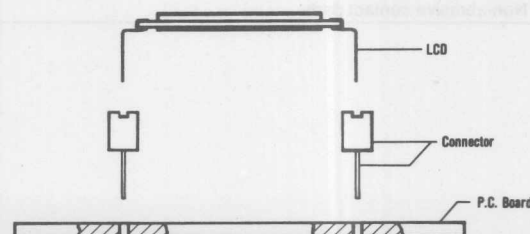


Figure 10





Liquid crystal displays are rapidly gaining in popularity and are being designed into a wide variety of applications. Their versatility, readability, and low power consumption make them extremely attractive for portable applications.

AND now presents an engineering bulletin describing various ways in which "direct drive, field effect" LCDs can be driven.

Introduction

This engineering bulletin has been prepared for the design engineer

or technician who may be unfamiliar with the way in which liquid crystal displays are manufactured, the way in which they operate and the requirements which are necessary for driving them electronically.

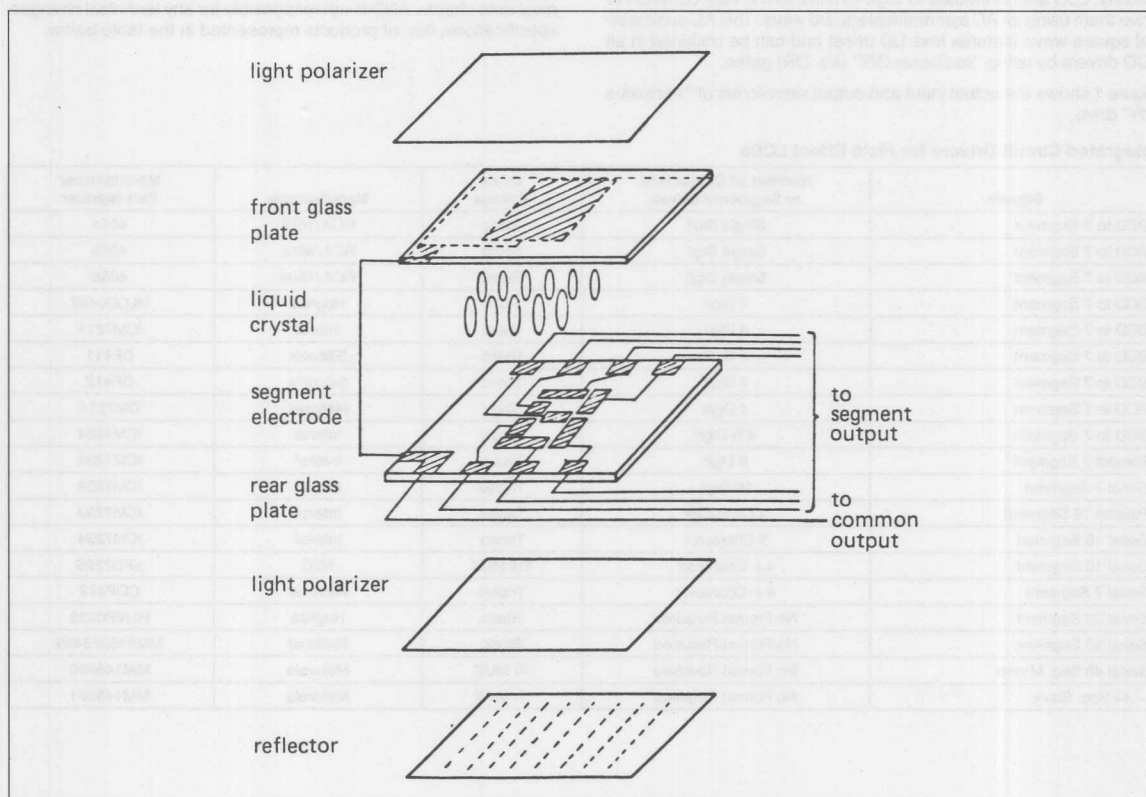
The object of this engineering bulletin is to provide the engineer or technician with a very basic understanding of how LCDs operate and how they can be driven with electronics.

As shown in the figure to the right, Field Effect Liquid Crystal Display Devices (FE-LCD) have two glass plates, the insides of which are coated with a pattern of transparent and conductive material. These are mounted such that the conducting layers are facing each other. The distance between the two plates is adjusted to about 10–30 μm (microns - 25 microns = .001").

Liquid crystal materials are retained between these plates by means of a peripheral seal of glass frit, epoxy or the like.

Both outer surfaces of the front and rear glass plates require light polarizing films which may or may not be crossed, depending on the function of the cell. The polarizing film on the rear glass is covered with a reflective material (silver bead, silver foil or gold foil) or a trans-reflective material (reflects ambient light and transmits back light).

LCDs are displayed by applying voltage between the segment and the common electrodes.





The Driving Method of the Field Effect, Direct Drive LCD

Driving Method

Numeric, symbolic and other patterns can be displayed by applying voltage between the segment and the common electrodes.

- Although a typical driving voltage is 5 Vrms, 3 Vrms to 10 Vrms can be used to drive AND LCDs.
- The allowable AC frequency range of the driving voltage is from 30 to 100 Hz.

Flicker may be seen by using a drive frequency below 30 Hz. As the power consumption increases in direct proportion to the driving frequency, we recommend driving LCDs using a frequency below 100 Hz.

Driving Waveform

Different from LEDs, LCDs should be driven with AC voltages to prevent plating of the conductive electrodes due to electrolysis.

Usually, LCD are connected to logic circuits so it is very common to drive them using an AC symmetrical square wave. This AC symmetrical square wave features less DC offset and can be obtained in all LCD drivers by using "exclusive OR" (Ex. OR) gates.

Figure 1 shows the actual input and output waveforms of "exclusive OR" drive.

Plot (A) is the control input waveform which selects the mode of the display. Plot (B) is the 32 Hz 50% duty-cycle square wave input to the "exclusive OR" gate, and is also input to the common electrode of LCD Plot (C).

Plot (D) is the output of the "exclusive OR" gate which has shifted the oscillator input 180° when the control input is high.

Plot (E) is the resultant waveform of Plot (C) and (D) is seen by the LCD.

Presently many LCD drivers include the exclusive OR gates; for instance, 10 volts between the segment and the common electrodes can be obtained with 5 volt power supply.

The specifications of several ICs and circuits are shown in Figure 2—Figure 4.

CD4055A, CD4056A, and MC14543 are most suitable for the seven segment numeric displays and CD4054A for the symbolic displays such as decimal point, colon, unit and so on. Several LCD integrated circuit manufacturers and models are listed in the chart below.

When you want to use these ICs, please refer to their individual technical data sheets. AND is not responsible for any technical changes, specifications, etc. of products represented in the table below.

Integrated Circuit Drivers for Field Effect LCDs

Signals	Number of Characters or Segments Driven	Drive Voltage	Manufacturer	Manufacturer Part Number
BCD to 7 Segment	Single Digit	Static	RCA/SGS	4054
BCD to 7 Segment	Single Digit	Static	RCA/Mitel	4055
BCD to 7 Segment	Single Digit	Static	RCA/Mitel	4056
BCD to 7 Segment	4 Digit	Static	Hughes	HLCD0437
BCD to 7 Segment	4 Digit	Static	Intersil	ICM7211
BCD to 7 Segment	4 Digit	Static	Siliconix	DF411
BCD to 7 Segment	4 Digit	Static	Siliconix	DF412
BCD to 7 Segment	4 Digit	Static	National	DM7211
BCD to 7 Segment	4½ Digit	Static	Intersil	ICM4224
Parallel 7 Segment	8 Digit	Triplex	Intersil	ICM7231
Serial 7 Segment	10 Digit	Triplex	Intersil	ICM7232
Parallel 16 Segment	4 Character	Triplex	Intersil	ICM7233
Serial 16 Segment	5 Character	Triplex	Intersil	ICM7234
Serial 16 Segment	4 + Character	1:4 MUX	NEC	μPD7225
Serial 7 Segment	4 + Character	Triplex	National	COP472
Serial 32 Segment	No Format Required	Static	Hughes	HLMP0438
Serial 32 Segment	No Format Required	Static	National	MM5452/5453
Serial 48 Seg. Master	No Format Required	¼ MUX	Motorola	MM145000
— 44 Seg. Slave	No Format Required	¼ MUX	Motorola	MM145001

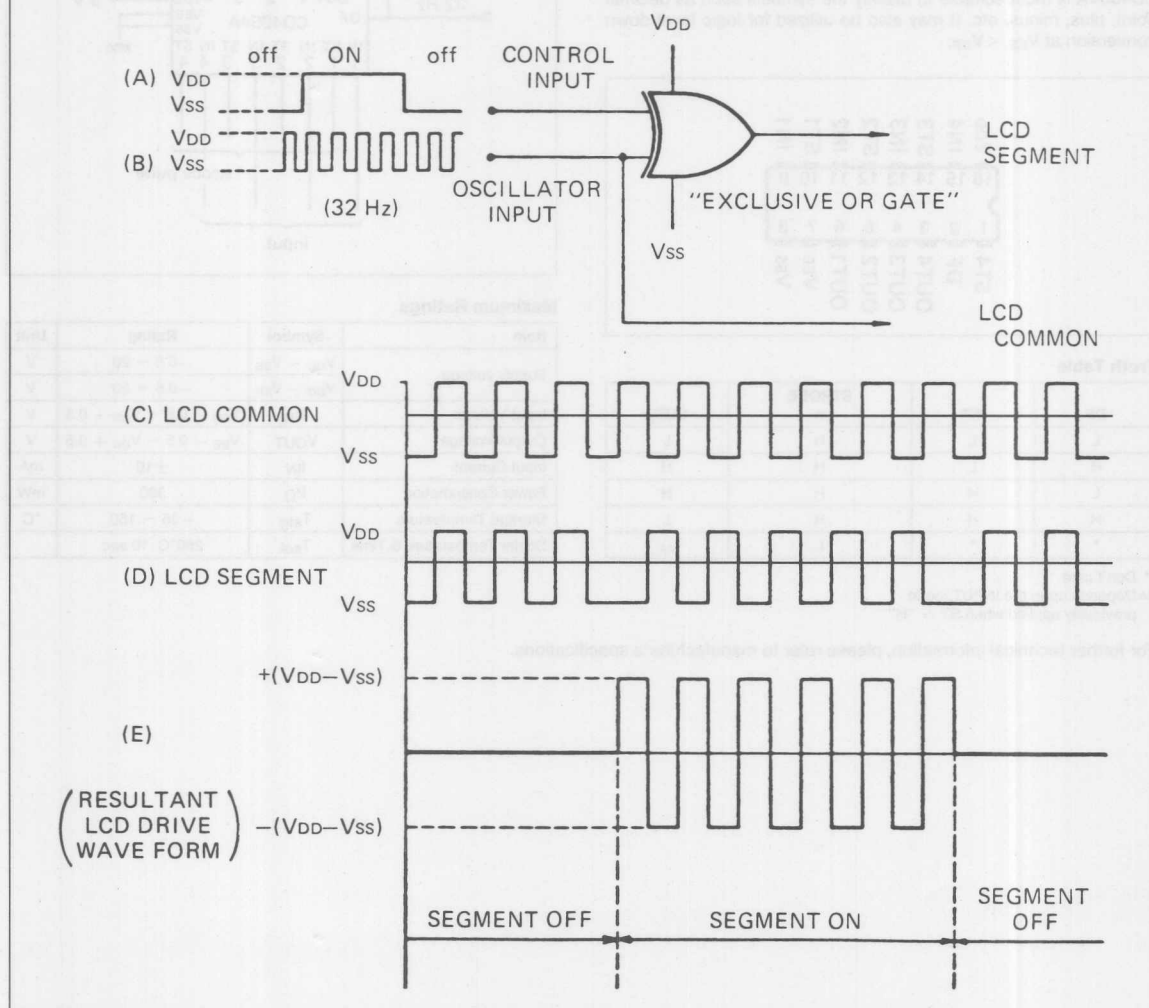
Special Attention for Circuit Design

- (A) It is recommended to connect the unused segment terminals to the common terminal; otherwise an undesired character or faint display may be seen. (NC pins which are not connected to the segment must not be connected to the common terminal.)
- (B) If there are some segments which are needed to be

displayed all the time, it can be simply achieved by applying the inverse signal which is inverted from common signal by an inverter to the segment terminals.

- (C) DC driving or AC driving which has large DC offset greatly shortens the life of the LCD; therefore, strict attention must be paid not to exceed the specified DC offset (25 mV).

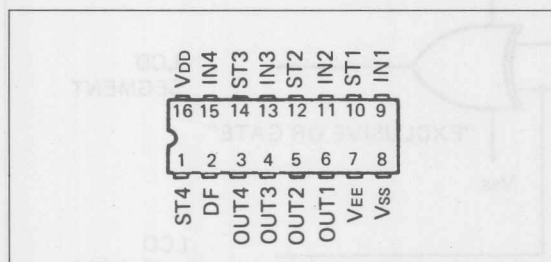
Figure 1. LCD Drive Waveform



Symbol Indicator Circuit

CD4054A is 4-segment display driver for FE LCD. When a square-wave is present at the DF input, the selected segments will have a square-wave output that is 180° out of phase with the DF input. Those segments which are not selected will have a square-wave output that is in phase with the input. when the input signal is high, LCD is directly driven by applying DF pulse to the common terminal of the LCD.

CD4054A is most suitable to display the symbols such as decimal point, plus, minus, etc. It may also be utilized for logic level down conversion at $V_{EE} < V_{SS}$.



Truth Table

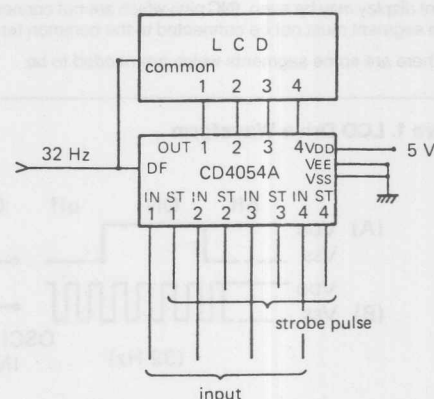
DF	INN	STROBE n	OUT _n
L	L	H	L
H	L	H	H
L	H	H	H
H	H	H	L
*	*	L	ΔΔ

* Don't care

ΔΔ Depends upon the INPUT mode
previously applied when ST = "H"

For further technical information, please refer to manufacturer's specifications.

Figure 2. 4 Segment Display Driver



Maximum Ratings

Item	Symbol	Rating	Unit
Supply voltage	$V_{DD} - V_{SS}$	-0.5 ~ 20	V
	$V_{DD} - V_{EE}$	-0.5 ~ 20	V
Input Voltage	V_{IN}	$V_{SS} - 0.5 \sim V_{DD} + 0.5$	V
Output Voltage	V_{OUT}	$V_{EE} - 0.5 \sim V_{DD} + 0.5$	V
Input Current	I_{IN}	±10	mA
Power Consumption	P_D	300	mW
Storage Temperature	T_{stg}	-65 ~ 150	°C
Solder Temperature & Time	T_{sol}	260°C .10 sec	

Segments Numerical

Display Circuit

CD4055A/CD4056A are single-digit BCD to 7-segment decoder/driver circuits for FE LCD.

When the DF input is high, the output segment will be high when selected by the BCD input.

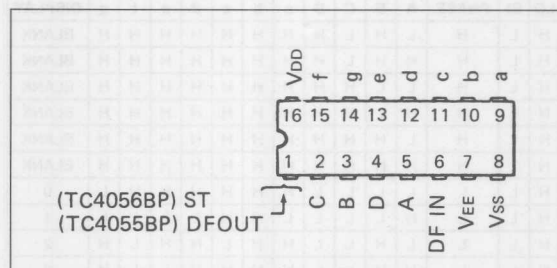
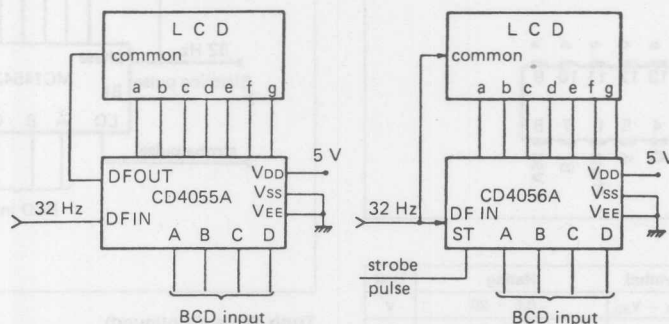
When the DF input is high, the output segment will be low

when selected by the BCD inputs.

Seven segment LCD is directly driven by applying the pulse that is in phase with the DF input to the common terminal of the LCD.

CD4055A is with the DF (Display Frequency) output. CD4056A is with the Strobed-Latch function. They may also be utilized for logic-level down conversion at $V_{EE} < V_{SS}$.

Figure 3. 7 Segment Decoder/Driver



Truth Table

ST = "H", DF = "L"

BCD INPUTS				SEGMENT OUTPUTS							DISPLAY CHARACTER
D	C	B	A	a	b	c	d	e	f	g	
L	L	L	L	H	H	H	H	H	H	L	0
L	L	L	H	L	H	H	L	L	L	L	1
L	L	H	L	H	H	L	H	H	L	H	2
L	L	H	H	H	H	H	H	L	L	H	3
L	H	L	L	L	H	H	L	L	H	H	4
L	H	L	H	H	L	H	H	L	H	H	5
L	H	H	L	H	L	H	H	H	H	H	6
L	H	H	H	H	H	H	L	L	L	L	7
H	L	L	L	H	H	H	H	H	H	H	8
H	L	L	H	H	H	H	H	L	H	H	9
H	L	H	L	L	L	L	H	H	H	L	L
H	L	H	H	L	H	H	L	H	H	H	H
H	H	L	L	H	H	L	L	H	H	H	P
H	H	L	H	H	H	H	L	H	H	H	R
H	H	H	L	L	L	L	L	L	L	H	—
H	H	H	H	L	L	L	L	L	L	L	BLANK

Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	$V_{DD} - V_{SS}$	-0.5 ~ 20	V
	$V_{DD} - V_{EE}$	-0.5 ~ 20	V
Input Voltage	V_{IN}	$V_{SS} - 0.5 \sim V_{DD} + 0.5$	V
Output Voltage	V_{OUT}	$V_{EE} - 0.5 \sim V_{DD} + 0.5$	V
Input Current	I_{IN}	± 10	mA
Power Consumption	P_D	300	mW
Storage Temperature	T_{stg}	-65 ~ 150	°C
Solder Temperature & Time	T_{sol}	260°C .10 sec	

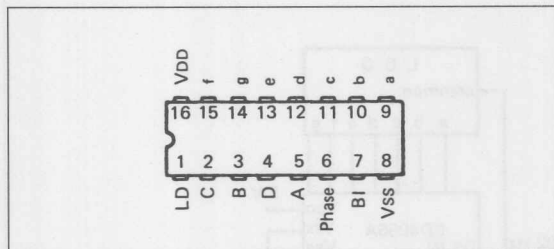
For further technical information, please refer to manufacturer's specifications.

**7 Segments Numerical
Display Circuit**

MC14543 is single digit BCD to 7-segment latch/decoder/driver with Blanking Input (BI) and Latch Disable (LD) Input for FE LCD.

The errored BCD input or the high "BI" will blank the display.

For LC display, square-wave is applied to the Phase input of the circuit and the common terminal of the LCD.

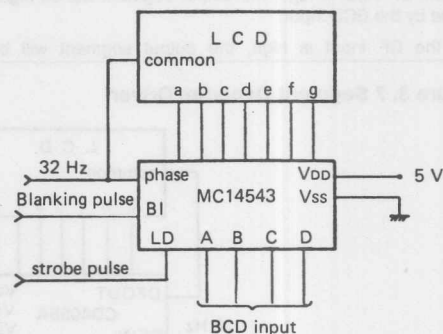
**Maximum Ratings**

Item	Symbol	Rating	Unit
Supply voltage	$V_{DD} - V_{SS}$	-0.5 ~ 20	V
	$V_{DD} - V_{EE}$	-0.5 ~ 20	V
Input Voltage	V_{IN}	$V_{SS} - 0.5 \sim V_{DD} + 0.5$	V
Output Voltage	V_{OUT}	$V_{EE} - 0.5 \sim V_{DD} + 0.5$	V
Input Current	I_{IN}	± 10	mA
Power Consumption	P_D	300	mW
Storage Temperature	T_{stg}	-65 ~ 150	°C
Solder Temperature & Time	T_{sol}	260°C .10 sec	

Truth Table

INPUTS							OUTPUTS							DISPLAY
LD	BI	PHASE	A	B	C	D	a	b	c	d	e	f	g	
*	H	H	*	*	*	*	H	H	H	H	H	H	H	BLANK
*	H	L	*	*	*	*	L	L	L	L	L	L	L	BLANK
L	L	H	*	*	*	*	LATCH							
L	L	L	*	*	*	*	LATCH							
H	L	H	L	L	L	L	L	L	L	L	L	L	H	0
H	L	H	H	L	L	L	H	L	L	H	H	H	H	1
H	L	H	L	H	L	L	L	L	H	L	L	H	L	2
H	L	H	H	H	L	L	L	L	L	L	H	H	L	3
H	L	H	L	L	H	L	H	L	L	H	H	L	L	4
H	L	H	H	L	H	L	L	H	L	L	H	L	L	5
H	L	H	L	H	H	L	L	H	L	L	L	L	L	6
H	L	H	H	H	H	L	L	L	L	H	H	H	H	7
H	L	H	L	L	L	H	L	L	L	L	L	L	L	8
H	L	H	H	L	L	H	L	L	L	L	H	L	L	9

For further technical information, please refer to manufacturer's specifications.

Figure 4. Segment Latch/Decoder/Driver**Truth Table (Continued)**

INPUTS							OUTPUTS							DISPLAY
LD	BI	PHASE	A	B	C	D	a	b	c	d	e	f	g	
H	L	H	L	H	L	H	H	H	H	H	H	H	H	BLANK
H	L	H	H	H	L	H	H	H	H	H	H	H	H	BLANK
H	L	H	L	L	H	H	H	H	H	H	H	H	H	BLANK
H	L	H	H	L	H	H	H	H	H	H	H	H	H	BLANK
H	L	H	L	H	H	H	H	H	H	H	H	H	H	BLANK
H	L	H	H	H	H	H	H	H	H	H	H	H	H	BLANK
H	L	L	L	L	L	L	H	H	H	H	H	L	L	0
H	L	L	H	L	L	L	L	H	H	L	L	L	L	1
H	L	L	L	H	L	L	H	H	L	H	H	L	H	2
H	L	L	H	H	L	L	H	H	H	H	L	L	H	3
H	L	L	L	L	H	L	L	H	H	L	L	H	H	4
H	L	L	H	L	H	L	H	L	H	H	L	H	H	5
H	L	L	L	H	H	L	H	L	H	H	H	H	H	6
H	L	L	H	H	H	HL	H	H	H	L	L	L	L	7
H	L	L	L	L	L	H	H	H	H	H	H	H	H	8
H	L	L	H	L	L	H	H	H	H	L	H	H	H	9
H	L	L	L	H	L	H	L	L	L	L	L	L	L	BLANK
H	L	L	H	H	L	H	L	L	L	L	L	L	L	BLANK
H	L	L	L	L	H	H	L	L	L	L	L	L	L	BLANK
H	L	L	L	L	H	H	L	L	L	L	L	L	L	BLANK
H	L	L	H	H	H	H	L	L	L	L	L	L	L	BLANK

*Don't care

Application Circuits

Figure	Description
5	3½ Digit Numerical Display
6	12 Digit Numerical Display
7	4 Digit Up/Down Counter
8	4 Digit Counter
9	4½ Digit Up/Down Counter
10	6 Digit Presettable Up/Down Counter
11	3½ Digit Ad Converter
12	3½ Digit Ad Converter
13	3½ Digit With Annunciators
14	4 Digit ⅓ Duty Multiplex
15	8 Digit Drive Scheme
16	2 x 32 Bar Graph Drive Scheme
17	13 Character (5 x 7 Dot Matrix)
	⅓ Duty Mpx.

Figure 5. 3½ Digit Numerical Display

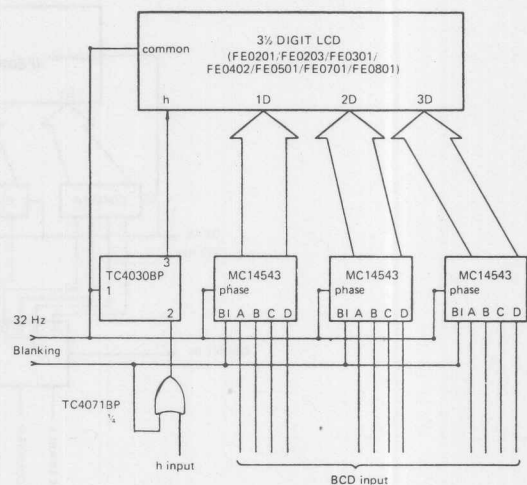
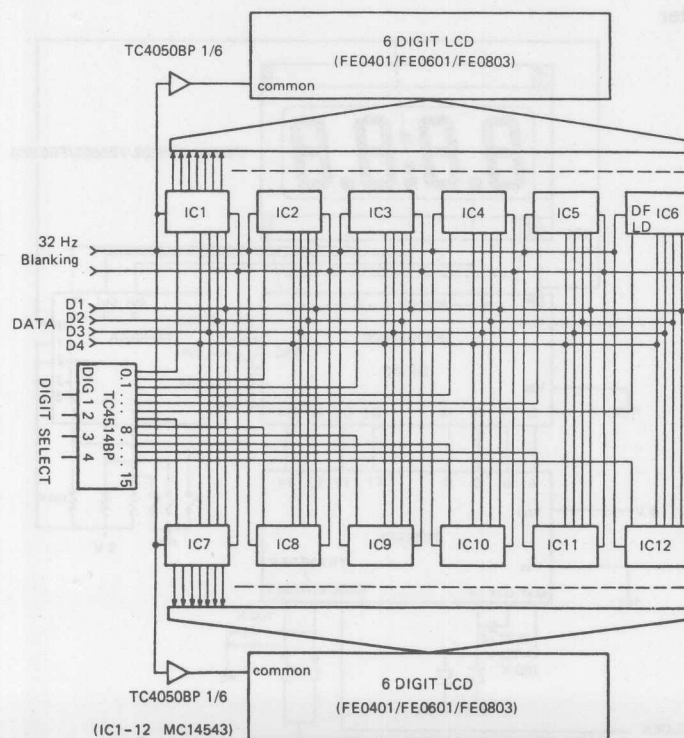


Figure 6. 12 Digit Numerical Display



For further technical information, please refer to manufacturer's specifications.

Figure 7. 4 Digit Up/Down Counter

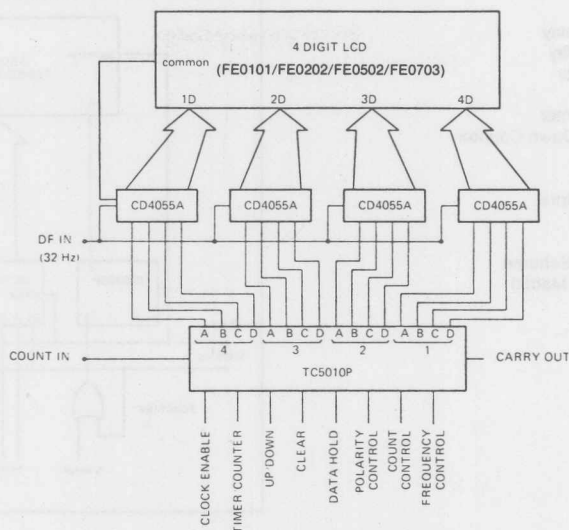
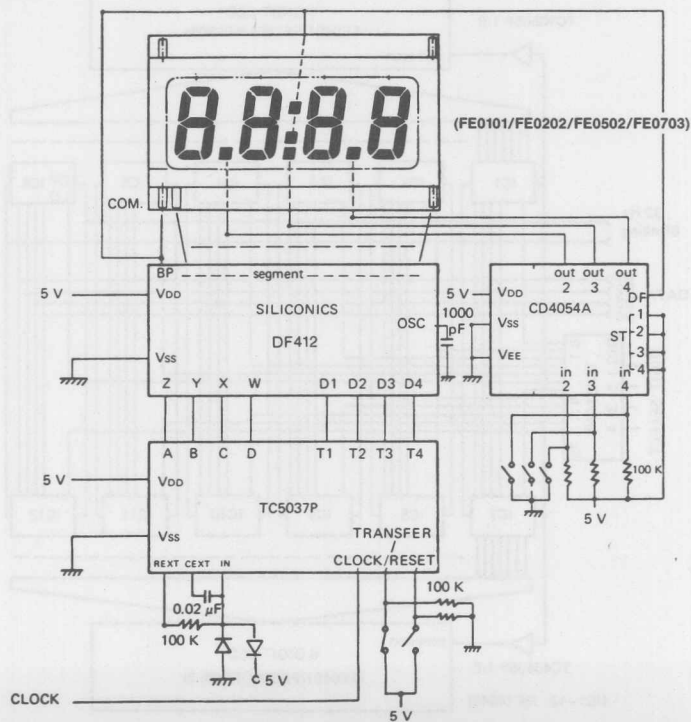


Figure 8. 4 Digit Counter



For further technical information, please refer to manufacturer's specifications.

Figure 9. 4½ Digit Up/Down Counter

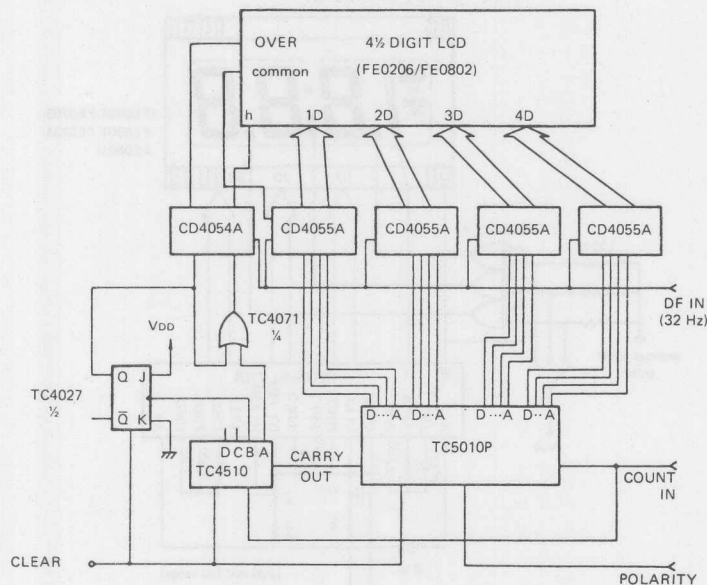
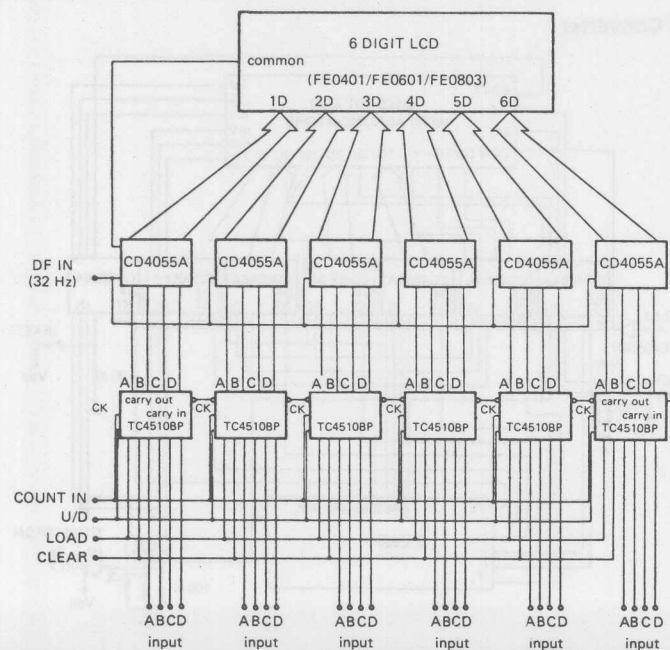


Figure 10. 6 Digit Counter



For further technical information, please refer to manufacturer's specifications.

Figure 11. 3½ Digit Ad Converter

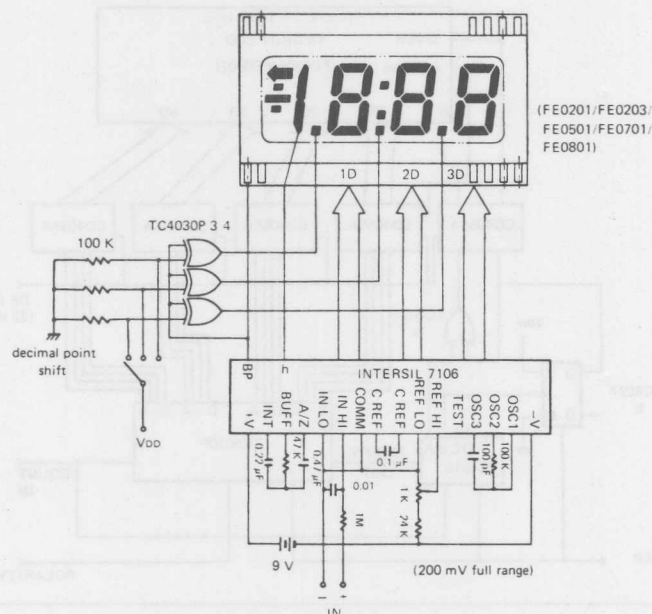
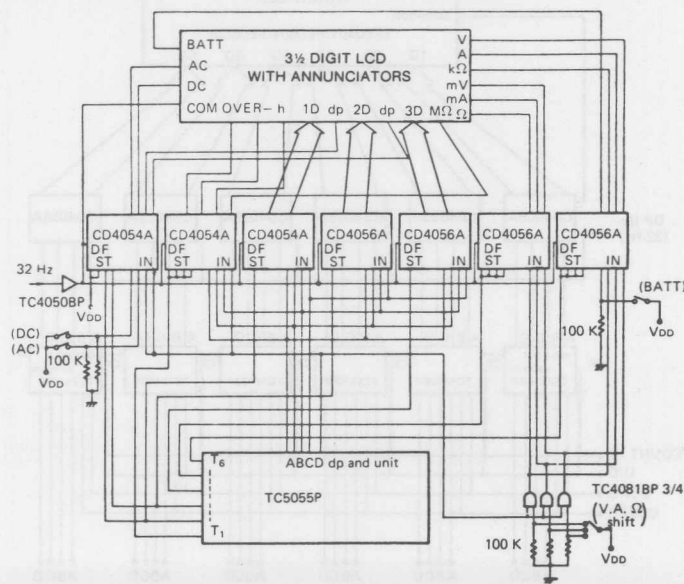


Figure 12. 3½ Digit A/D Converter



For further technical information, please refer to manufacturer's specifications.

Figure 13. 3½ Digit with Annunciators

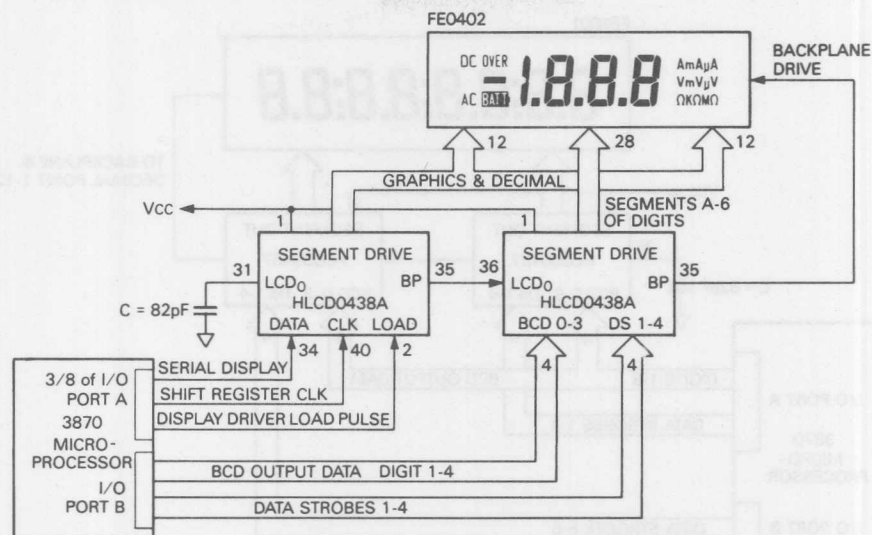
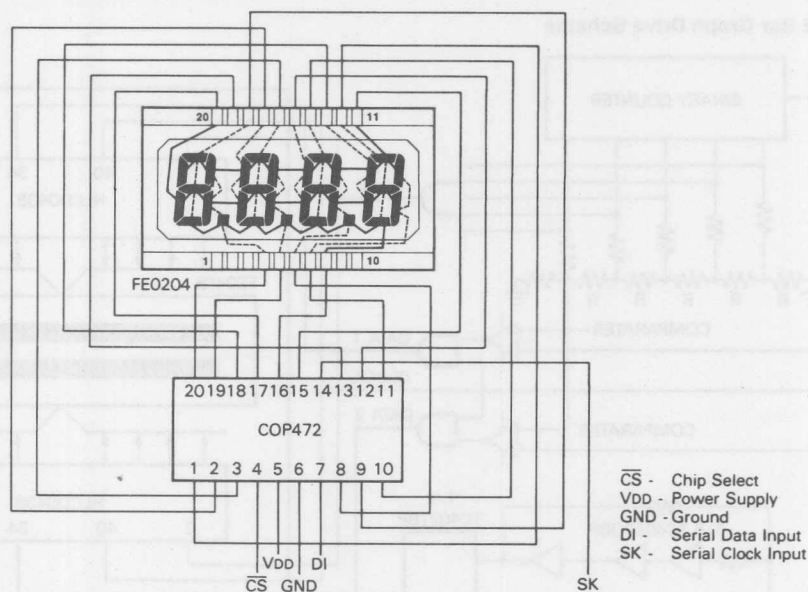


Figure 14. 4 Digit 1/3 Duty Multiplex



For further technical information, please refer to manufacturer's specifications.

Figure 15. 8 Digit Drive Scheme

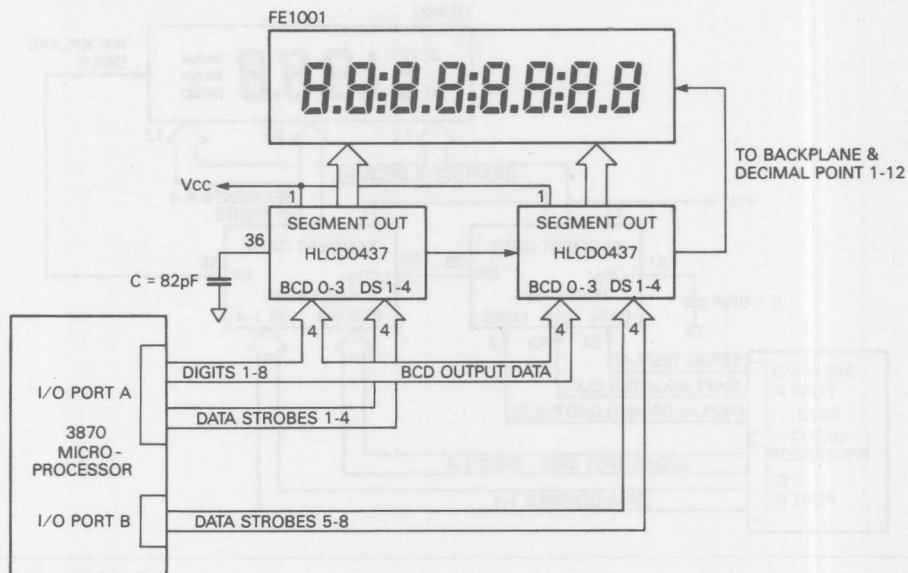
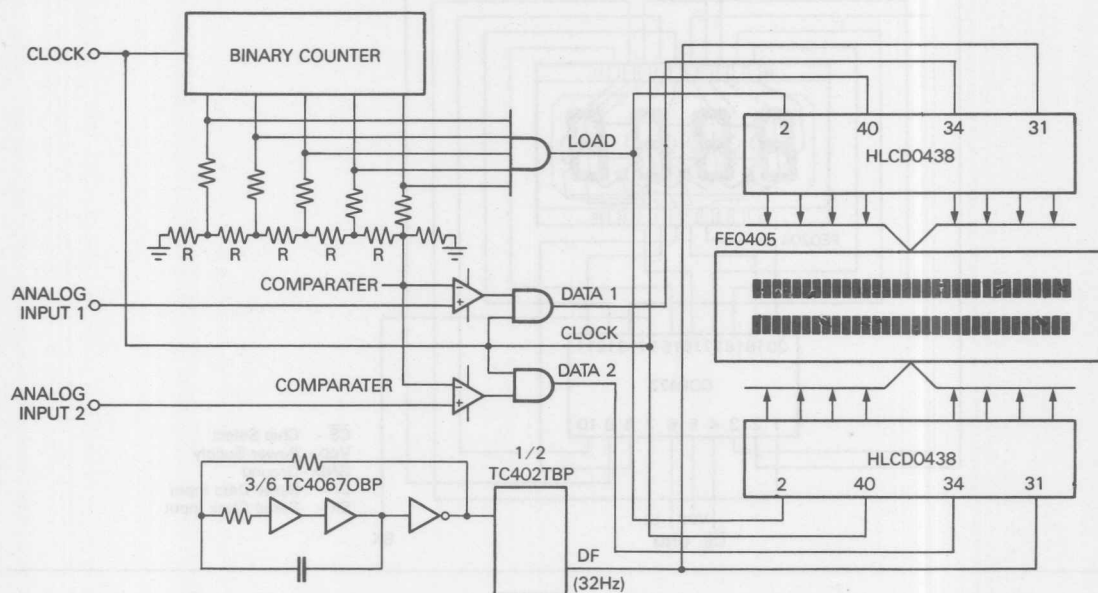


Figure 16. 2 x 32 Bar Graph Drive Scheme



For further technical information, please refer to manufacturer's specifications.



Data in this section provides interface specifications for the AND character dot matrix modules.

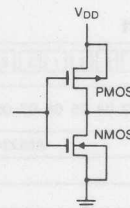
- AND241 16 characters x 1 line
- AND671 16 characters x 1 line
- AND691 24 characters x 1 line
- AND601 40 characters x 1 line
- AND491 16 characters x 2 lines
- AND501 20 characters x 2 lines
- AND771 24 characters x 2 lines
- AND591 40 characters x 2 lines
- AND731 16 characters x 4 lines
- AND721 20 characters x 4 lines

Connector Pin Assignment for Interface

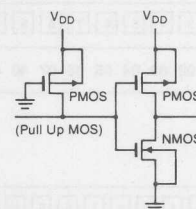
Pin No.	Signal	Function	
1	GND	OV	Power Supply
2	V _{DD}	5V	
3	V _O	LCD Drive Voltage (OV to V _{DD})	
4	RS	"H" Data Input "L" Command Input	
5	R/ \overline{W}	"H" Data Read (Module → CPU) "L" Data Write (CPU → Module)	
6	E	Enable Signal	
7	DB0	<div><div>8-bit Use</div><div>4-bit Use</div></div>	
8	DB1		
9	DB2		
10	DB3		
11	DB4		
12	DB5		
13	DB6		
14	DB7		

Terminal Characteristics

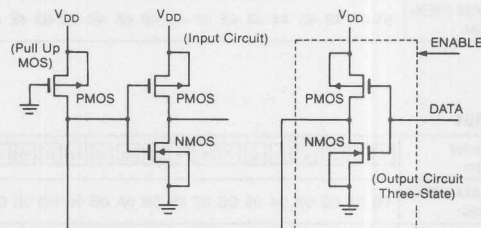
Input Terminal: E



Input Terminals: RS, R/W



I/O Terminals: DB0 to DB7



When input is at the intermediate level with CMOS, excessive current flows through the input circuit to the power supply. To avoid this, input level must be fixed at high or low. t_{OFF} stipulates the time of power OFF for power supply instantaneous dip or when power supply repeats ON and OFF.



Relation between Character Position and Character Address

AND241, AND691, AND601

Character Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
DD RAM (HEX) Address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F	20	21	22	23	24	25	26	27
Module Type	AND241																																							
																	AND691																							

AND671

Character Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DD RAM (HEX) Address	00	01	02	03	04	05	06	07	40	41	42	43	44	45	46	47

AND491

Character Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DD RAM (HEX) Address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
Character Position	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
DD RAM (HEX) Address	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F

AND501

Character Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
DD RAM (HEX) Address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13
Character Position	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
DD RAM (HEX) Address	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53

AND591

Character Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
DD RAM (HEX) Address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F	20	21	22	23	24	25	26	27
Character Position	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
DD RAM (HEX) Address	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F	60	61	62	63	64	65	66	67



Relation between Character Position and Character Address (Continued)

AND771

Character Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
DD RAM (HEX) Address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13	14	15	16	17
Character Position	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
DD RAM (HEX) Address	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53	54	55	56	57

AND731

Character Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DD RAM (HEX) Address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
Character Position	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
DD RAM (HEX) Address	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
Character Position	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
DD RAM (HEX) Address	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
Character Position	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
DD RAM (HEX) Address	50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F

AND721

Character Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
DD RAM (HEX) Address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13
Character Position	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
DD RAM (HEX) Address	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53
Character Position	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
DD RAM (HEX) Address	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F	20	21	22	23	24	25	26	27
Character Position	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
DD RAM (HEX) Address	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F	60	61	62	63	64	65	66	67

Timing Characteristics ($T_A = 25^\circ\text{C}$)

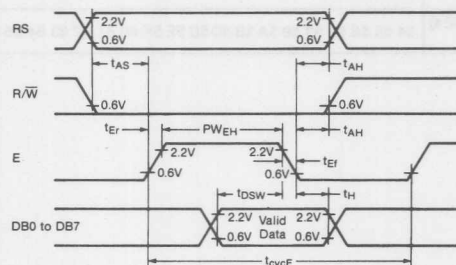
Data Write

Item	Symbol	Value		Unit
		Min.	Max.	
Enable Cycle Time	t_{cyCE}	1000		ns
Enable Pulse Width	PW_{EH}	450		
Enable Rise/Fall Time	$t_{\text{Er}}, t_{\text{Ef}}$		25	
Set Up Time	t_{AS}	140		
Address Hold Time	t_{AH}	10		
Data Set Up Time	t_{DSW}	195		
Data Hold Time	t_{H}	10		

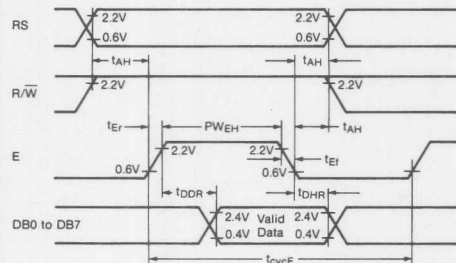
Data Read

Item	Symbol	Value		Unit
		Min.	Max.	
Enable Cycle Time	t_{cyCE}	1000		ns
Enable Pulse Width	PW_{EH}	450		
Enable Rise/Fall Time	$t_{\text{Er}}, t_{\text{Ef}}$		25	
Set Up Time	t_{AS}	140		
Address Hold Time	t_{AH}	10		
Data Delay Time	t_{DDR}		320	
Data Hold Time	t_{DHR}	20		

Data Write



Data Read

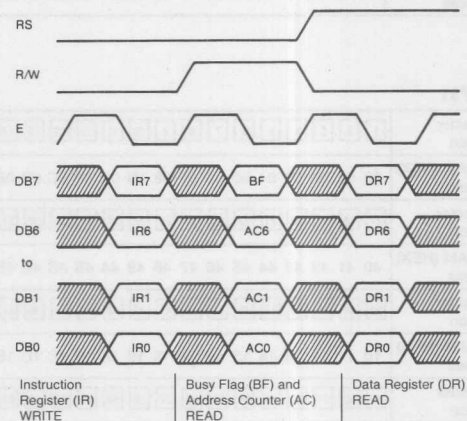


Data Transfer Example

The data can be sent in the form of either 2 cycles of 4-bit data or 1 cycle of 8-bit data so that it can be connected to both 4 and 8-bit CPU's.

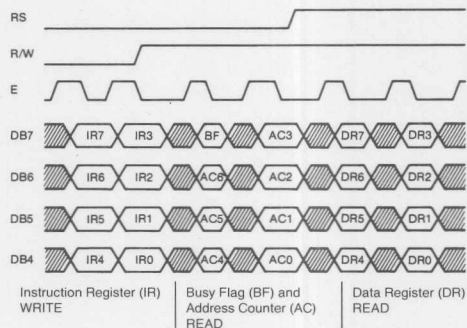
- (1) When data is 8 bits long, the data is transferred by using 8 data lines of DB0 to DB7.

8 bit Data Transfer Example



- (2) When data is 4 bits long, it is transferred by using only 4 lines of DB7 to DB4, DB3 to DB0 are not used. Data transfer between the module and a 4-bit CPU is completed when the higher order 4 bits are transferred first, followed by the lower order 4 bits.

4 bit Data Transfer Example



Function of Registers

1. Instruction Register and Data Register

The LCD module's built-in controller has two 8-bit registers, an Instruction Register (IR) and a Data Register (DR). IR stores instruction codes such as display clear and cursor shift, address information of display data RAM (DD RAM), and character generator RAM (CG RAM).

IR can be written to by a CPU, but a CPU cannot read IR.

The DR temporarily stores data to be written into the DD RAM or the CG RAM. Data written into the DR is automatically sent to the DD RAM or the CG RAM as an internal operation. The DR is also used for data storage when reading data from the DD RAM or the CG RAM. When address information is written into the IR, data is transferred to the DR from the DD RAM or the CG RAM as an internal operation. Then, the CPU reads the DR and data transfer is completed. After the CPU reads the DR, data of the DD RAM or the CG RAM at the next address is sent to DR for the next reading.

Register Selector (RS) signals select these two registers.

Table 1. Register Selection

RS	R/W	Operation
0	0	IR write as internal operations (display clear, etc.)
0	1	Read of a Busy Flag (DB7) and Address Counter (DB0 to DB6)
1	0	DR Write as internal operations (DR → CG or CG RAM)
1	1	DR Read as internal operations (DD or CG RAM → DR)

2. Busy Flag (BF)

When the Busy Flag is "1", the LCD module is in the internal operation mode, and the next instruction is not accepted at this time. As shown in Table 1, the Busy Flag is shown in DB7 when RS=0 and R/W=1. The next instruction must be written after checking that the Busy Flag is "0".

3. Address Counter (AC)

The address counter (AC) assigns DD and CG RAM address. When an instruction for address setting is written in IR, the address information is sent from IR to AC.

Selection of either the DD or CG RAM is also determined by an instruction. After writing into (or reading from) DD or CG RAM display data. AC is automatically incremented by +1 (or decremented by -1). Data in address counters (AC) are in DB6 to DB0 when RS=0 and R/W=1, as shown in Table 1.

4. Display Data RAM (DD RAM)

The display data RAM (DD RAM) stores display data represented in 8-bit character codes.

Relationship between the DD RAM address and display position on LCD Display is shown on page 210 and 211.

Commands

The command code refers to the signal through which the LCD module is accessed through the CPU, the LCD module begins operation upon receipt of the code input.

As the internal processing operation of the LCD module is started with a timing that does not affect the LCD display, the busy status continues longer than the CPU cycle time.

Under the busy status (when the busy flag is set to "1"), the LCD module does not execute any commands other than the busy flag read.

For this reason, the CPU has to verify that the busy flag is set to "0" prior to the input of the command code.

Table 2 shows the commands and the execution times for the commands. The commands can be divided into the following 4 types.

- Commands that designate the module functions such as display format, data length, etc.
- Commands that give internal RAM addresses.
- Commands that perform data transfer with internal RAM.
- Other commands.



Table 2. Command List

Command	Command Code										Description	Execution Time (max) Note (1)	Execution Time (max) Note (2)	
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0				
Clear Display Note (4)	0	0	0	0	0	0	0	0	0	1	Clear all of the display and return the cursor to the home position (Address 0).	1.64ms	4.9ms	
Return Home	0	0	0	0	0	0	0	0	0	1	X	Return the cursor to the home position (Address 0). Also return the display being shifted to the original position. DD RAM contents remain unchanged.	1.64ms	4.8ms
Entry Mode Set	0	0	0	0	0	0	0	0	1	I/ \overline{D}	S	Set the cursor move direction and specify to or not to shift the display. These operations are performed during data write.	40 μ s	120 μ s
Display ON/OFF Control	0	0	0	0	0	0	0	1	D	C	B	Set ON/OFF of entire display (D), cursor ON/OFF (C), and blinking of cursor position (B).	40 μ s	120 μ s
Cursor and Display Shift	0	0	0	0	0	1	S/C	R/L	X	X		Move the cursor and shift the display without changing DD RAM contents	40 μ s	120 μ s
Function Set	0	0	0	0	1	DL	N	F	X	X		Set interface data length (DL) number of display lines (L) and character font (F).	40 μ s	120 μ s
Set RAM Address	0	0	0	1	ACG						Set the CG RAM address, CG Ram data is sent and received after this setting	40 μ s	120 μ s	
Set DD RAM Address	0	0	1	ADD						Set the DD RAM address. DD RAM data is sent and received after this setting.	40 μ s	120 μ s		
Read Busy Flag & Address	0	1	BF	AC						Read Busy flag (BF) indicating internal operation is being performed and reads address counter contents.	40 μ s	120 μ s		
Write Data to CG or DD RAM	1	0	Write Data						Write Data from DD RAM or CG RAM		40 μ s	120 μ s		
Read Data to CC or DD RAM	1	1	Read Data						Read Data from DD RAM or CG RAM.		40 μ s	120 μ s		
	I/ \overline{D} =1 : Increment I/D=0: Decrement S=1 : Accompanies display shift S/C=1 : Display shift S/C=0: Cursor move R/L=1 : Shift to the right R/L=0 : Shift to the left DL=1 : 8 bits DL=0: 4 bits N=1 : 2 lines N=0: 1 line F=1 : 5 x 10 dots F=0: 5 x 7 dots BF=1 : Internally operating BF=0 : Can accept instruction										DD RAM : Display Data RAM CG RAM : Character Generator RAM ACG : CG RAM Address ADD : DD RAM Address Corresponds to Cursor Address. AC : Address Counter used for both DD and CG RAM Address.			

X=Don't care

Notes:

1. Applies to: AND241, AND671, AND691, AND491, AND501
2. Applies to: AND591, AND721, AND731, AND771
3. Instruction Cursor and Display Shift are invalid for the AND671.
4. The repeat time interval of instruction Clear Display must be 13 ms min. (5 x 7 dot font) and 18 ms min. (5 x 10 dot font).

**1. Clear Display**

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	0	0	1

Write space code "20" (Hexadecimal) into all the DD RAM addresses. The cursor returns to address 0 (DD RAM Address="00H") and display, it it has been shifted, it returns to the original position. In other words, display disappears and the cursor goes to the left edge of the first line.

2. Return Home

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	0	1	X

Return the cursor to character position 1 (DD RAM Address="00H") and returns the display to the original position if it has been shifted (S in the instruction register is 1). The DD RAM contents remain unchanged.

3. Entry Mode Set

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	1	I/D	S

I/D: Increment (I/D=1) or decrement (I/D=0) the DD RAM address by one upon writing a character code into the DD RAM or reading a character code from the DD RAM. The cursor moves to the right when I/D=1, and to the left when I/D=0.

S : Shift the entire display to the right (when I/D=0, S=1) or the left (when I/D=1, S=1) when writing to the DD RAM. Therefore, the cursor looks as if it stood still and display only moves. Display is not shifted when reading from the DD RAM. Display is not shifted when S=0.

4. Display ON/OFF Control

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	1	D	C	B

D : Display is turned ON when D=1 and OFF when D=0. When display is turned off due to D=0, the display data remains in the DD RAM and they can be displayed immediately by setting D=1.

C : The cursor is displayed when C=1 and not displayed when C=0. Even if the cursor disappears, function of I/D, etc. does not change during "display data write." The cursor is displayed at the 8th line when the 5 x 7 dots character font is selected.

B : The character at the cursor position blinks when B=1. The blink is done by switching between all black dots and display characters at 0.4 second interval. The cursor and the blink can be set concurrently.

X=Don't care

5. Cursor or Display Shift

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	1	S/C	R/L	X	X

Shift the cursor position or display position to the right or the left without writing or reading the display data. This function can be used for correction or search of display.

S/C	R/L	Function
0	0	Shift the cursor position to the left. (AC is decremented by one.)
0	1	Shift the cursor position to the right. (AC is incremented by one.)
1	0	Shift the entire display to the left. The cursor follows the display shift.
1	1	Shift the entire display to the right. The cursor follows the display shift.

6. Function Set

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	1	DL	N	F	X	X

DL : Set the interface data length. Data is sent or received in 8-bit length (DB7 to DB0) when DL=1 and 4-bit length (DB7 to DB4) when DL=0. When 4-bit length is selected, data must be sent or received twice.

N : Set number of display lines.

F : Set character font. The 5 x 7 dots character font is selected when F=0, while 5 x 10 dots character font is selected when F=1 and N=0.

N	F	No. of Display Lines	Character Font	Duty Ratio	Module Type No.
0	0	1	5x7 Dots	1/8	AND241, AND691, AND601
0	1	1	5x10 Dots	1/11	AND241, AND691, AND601
1	0	2	5x7 Dots	1/16	AND671, AND491, AND501 AND771, AND591
1	0	4	4x7 Dots	1/16	AND731, AND721

7. Set CG RAM Address

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	1	A	A	A	A	A	A

Set the CG RAM address to a binary number of AAAAAA in the address counter. After execution of this instruction, all the data from MPU is written into the CG RAM and all the data is read from CG RAM.

**8. Set DD RAM Address**

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	1	An	A	A	A	A	A	A

Set the DD RAM address to a binary number of AnAAAAAA in the address counter. (An=0 for the first line, An=1 for the second line). After execution of this instruction, all the data from MPU is written into the DD RAM and all the data is read from DD RAM.

9. Read Busy Flag and Address

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	1	BF	A	A	A	A	A	A	A

Read Busy Flag (BF) and the value of the address counter (AAAAAA). BF=1 indicates that an internal operation is going on the next command is not accepted until BF becomes "0". It is necessary to check the BF status before the next write operation. The address counter is used for the CG or DD RAM address.

10. Write Data to CG RAM or DD RAM

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	1	0	D	D	D	D	D	D	D	D

Write binary 8-bit data DDDDDDDD to the CG RAM or the DD RAM. Whether the CG RAM or the DD RAM is to be written is determined by the previous designation (CG RAM address setting or DD RAM address setting). After writing, the address is automatically incremented or decremented by one according to entry mode. Display shift also follows the entry mode.

11. Read Data from CG RAM or DD RAM

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	1	1	D	D	D	D	D	D	D	D

Read binary 8-bit data DDDDDDDD from the CG RAM or the DD RAM. Whether the CG RAM or the DD RAM is to be read is determined by the previous designation. Prior to inputting this read command, either the CG RAM address set command or the DD RAM address set command must be executed. If it is not done, the first data read is invalid, and the second data read of the next address can be read normally. After reading, the address is automatically incremented or decremented by one according to the entry mode. However, display shift is not performed regardless of entry mode.

Character Patterns and Character Codes**1. Character Generator ROM (CG ROM)**

The character generator ROM generates 5 x 7 dot (160 kinds) character patterns or 5 x 10 dot (32 kinds) character patterns from an 8-bit DD RAM character code signal.

When the 8-bit character code of the CG ROM is written into the DD RAM, the character pattern of the CG ROM corresponding to the code is displayed on the LCD display position corresponding to the DD RAM address. Table 3 shows the relation between character patterns and character codes.

Note:

AND671, AND491, AND501, AND591, AND771, AND731 and AND721 can only use 5 x 7 dot character patterns.

2. Character Generator RAM (CG RAM)

The character generator RAM is used for original character patterns other than for the CG ROM. The CG RAM has the capacity (64 bytes=512 bits) to write 8 types of character patterns with 5 x 7 font, and 4 types with 5 x 10 font. When displaying character patterns stored in the CG RAM, write 8-bit character codes (00 to 07 or 02 to 0F; hex.) on the left side as shown in Table 3.

Table 4 shows the relation between CG RAM addresses and data and display patterns for 5 x 7 dots.

Table 5 shows the relation between CG RAM addresses and data and display patterns for 5 x 10 dots.

Table 3. Character Pattern and Character Code

Upper 4 bit Lower 4 bit	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
XXXX0000	CG RAM (1)		0	1	2	3	4	5	6	7	8	9	A
XXXX0001	(2)		B	C	D	E	F	G	H	I	J	K	L
XXXX0010	(3)		M	N	O	P	Q	R	S	T	U	V	W
XXXX0011	(4)		X	Y	Z	[\]	^	_	`	a	b
XXXX0100	(5)		c	d	e	f	g	h	i	j	k	l	m
XXXX0101	(6)		n	o	p	q	r	s	t	u	v	w	x
XXXX0110	(7)		y	z	{		}	~					
XXXX0111	(8)												
XXXX1000	(1)												
XXXX1001	(2)												
XXXX1010	(3)												
XXXX1011	(4)												
XXXX1100	(5)												
XXXX1101	(6)												
XXXX1110	(7)												
XXXX1111	(8)												

Relation between CG RAM Address and Character Code (DD RAM) and Character Pattern (CG RAM Data)

Table 4. 5 x 7 Dots Character Pattern

Character Code (DD RAM Data)	CG RAM Address	Character Pattern (CG RAM Data)
7 6 5 4 3 2 1 0	5 4 3 2 1 0	7 6 5 4 3 2 1 0
0 0 0 0 X 0 0 0	0 0 0	X X X 0 0 0 0 0
	0 0 1	X X X 0 0 0 0 0
	0 1 0	X X X 0 1 0 0 1
	0 0 0 1 1	X X X 1 0 1 0 1
	1 0 0	X X X 1 0 0 1 0
	1 0 1	X X X 1 0 0 1 0
	1 1 0	X X X 0 1 1 0 1
	1 1 1	X X X 0 0 0 0 0
0 0 0 0 X 0 0 1	0 0 0	X X X 0 0 0 0 0
	0 0 1	X X X 0 0 0 0 0
	0 1 0	X X X 0 1 1 1 0
	0 0 1 0 1 1	X X X 1 0 0 0 1
	1 0 0	X X X 1 0 0 0 1
	1 0 1	X X X 0 1 0 1 0
	1 1 1	X X X 1 1 0 1 1
	1 1 1	X X X 0 0 0 0 0

X = Don't care

Notes:

- Character code bits 0 to 2 correspond to CG RAM address bits 3 to 5 (3 bits: 8 types).
- CG RAM address bits 0 to 2 designate character pattern line position. The 8th line is the cursor position and the display is presented in logical OR with cursor.
- Character pattern row positions correspond to CG RAM data bits 0 to 4, as shown in the figure (bit 4 being at the left end). Since the CG RAM data bits 5 to 7 are not used for the display, they can be used as general data RAM.
- As shown in Table 4, CG RAM character patterns are selected when character code bits 4 to 7 are all "0". However, since character code bit 3 is the "Don't care bit", "α" display in the character pattern, for example, is selected by character code "00" or "08".
- "1" for CG RAM data corresponds to selection for display and "0" for non-selection.

Table 5. 5 x 10 Dots Character Pattern

Character Code (DD RAM Data)	CG RAM Address	Character Pattern (CG RAM Data)
7 6 5 4 3 2 1 0	5 4 3 2 1 0	7 6 5 4 3 2 1 0
0 0 0 0 X 0 0 X	0 0 0 0	X X X 0 0 0 0 0
	0 0 0 1	X X X 0 0 0 0 0
	0 0 1 0	X X X 1 1 1 1 1
	0 0 1 1	X X X 0 0 1 0 0
	0 1 0 0	X X X 1 1 1 1 1
	0 0 0 1 0 1	X X X 1 0 1 0 1
	0 1 1 0	X X X 1 0 1 0 1
	0 1 1 1	X X X 1 1 1 1 1
	1 0 0 1	X X X 0 0 0 0 0
	1 0 0 1	X X X 1 1 1 1 1
	1 0 1 0	X X X 0 0 0 0 0
	1 0 1 1	X X X X X X X X
	1 1 0 0	X X X X X X X X
	1 1 0 1	X X X X X X X X
	1 1 1 0	X X X X X X X X
	1 1 1 1	X X X X X X X X

X = Don't care

Notes:

- Character code bits 1 and 2 correspond to CG RAM address bits 4 and 5 (2 bits: 4 types).
- CG RAM address bits 0 to 3 designate character pattern line position. The 11th row is the cursor position.
- Character pattern row positions correspond to CG RAM data bits 0 to 4, as shown in the figure (bit 4 being at the left end).
- As shown in Table 5, CG RAM character patterns are selected when character codes bits 4 to 7 are all "0". However, since character code bit 0 and 3 are the "Don't care bit", "Φ" display in the character pattern, for example, is selected by character codes "00", "01", and "08" and "09".
- "1" for CG RAM data corresponds to selection for display and "0" for non-selection.

Initialization (Reset)

1. Automatic Initialization

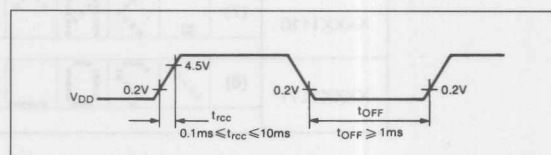
The LCD module is automatically initialized when the power is turned on (using internal reset circuit). The following commands are executed in initialization. The busy flag is kept in the busy state (BF # EQ 1) until initialization ends. The busy state is kept about 10ms after VDD level reaches 4.5V.

- Clear display
- Function set
 - Data length of interface with MPU: 8-bit (DL=1)
 - LCD: 1-line display (N = 0)
 - Character font: 5 x 7 dots (F = 0)
- Display ON/OFF control
 - Display: Display OFF (D = 0)
 - Cursor: Cursor OFF (C = 0)
 - Blink: Blink OFF (B = 0)
- Entry mode set
 - Address counter: Increment + 1 (I/D = 1)
 - Display shift: No shift (S = 0)

(e) DD RAM is selected

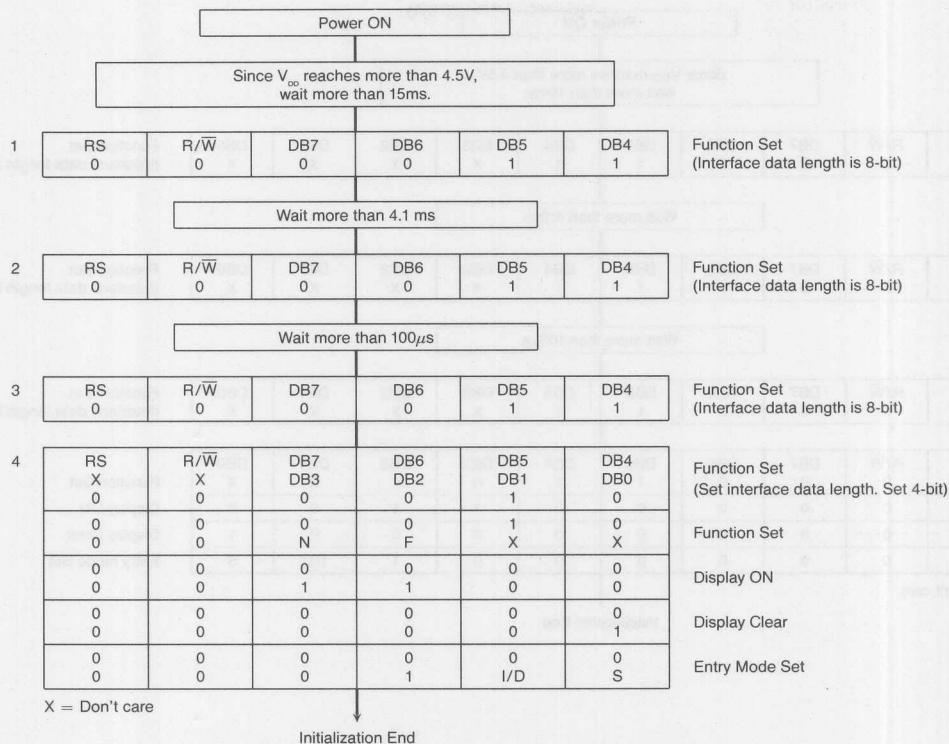
Above function set command in automatic initialization does not always meet each module, in this case it is necessary to reset "Function Set" command (refer to Command section, page 5-25).

Note: Power on timing shown below is necessary in order to perform automatic initialization. When the above power supply condition is not satisfied, the internal reset circuit will not operate normally. In this case, perform the initialization by sending commands from CPU after turning the power ON.



2. Manual Initialization Procedure

(a) When the interface data length is 4-bit

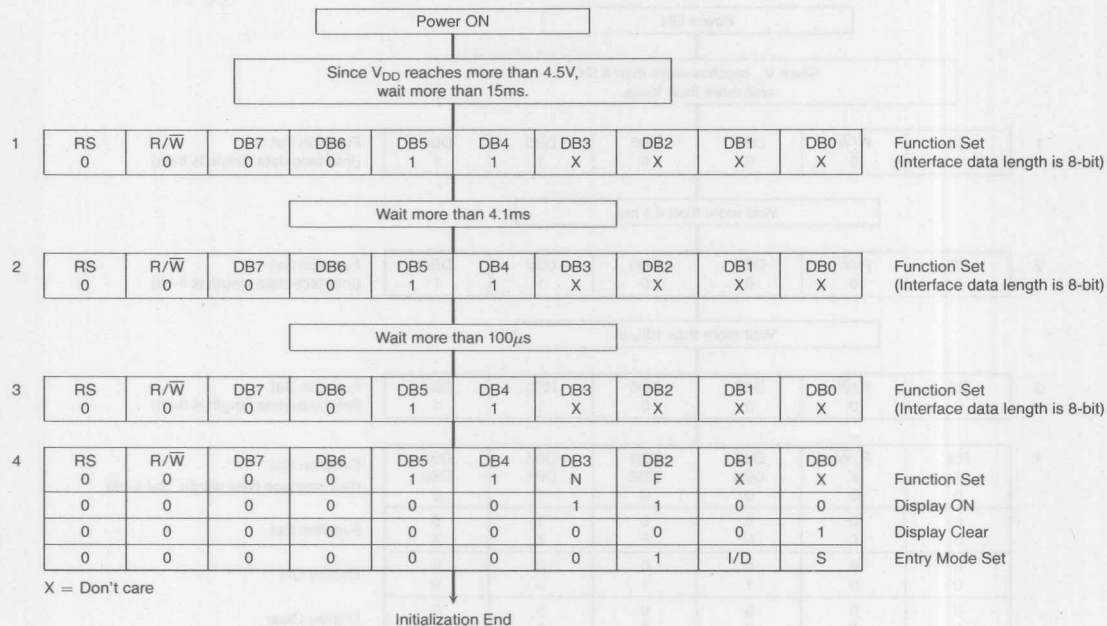


Notes:

- (1) Before initialize step 1, 2 and 3, can not check busy flag
- (2) After initialize step 4, cannot change function set mode, number of display lines and character font.

2. Manual Initialization Procedure (Continued)

(b) When the interface data length is 8-bit



Notes:

- (1) Before initialize step 1, 2 and 3, can not check busy flag.
- (2) After initialize step 4, cannot change function set, number of display lines and character font.



Example of Operation (AND501)

Table 6. 4-bit Operation

Command						Display	Operation
Power Supply ON (Internal Reset Circuit)							Initialized. No display appears.
Initialization							Initialized. No display appears.
Display ON/OFF Control							
RS	R/W	DB7	DB6	DB5	DB4		
0	0	0	0	0	0		
0	0	0	1	1	0		Turn on display and cursor. All display is in space mode because of initialization.
Set DD RAM Address						—	Set RAM address so that the cursor is positioned at the head of 1st line.
0	0	1	0	0	0		
0	0	0	0	0	0		
Write Data to CG/DD RAM						A _—	Write A _— . The cursor is incremented by one and shifts to the right.
1	0	0	1	0	0		
1	0	0	0	0	1		

Table 7. 8-bit Operation

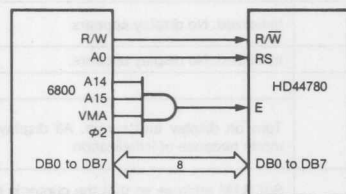
Command										Display	Operation
Power Supply ON (Internal Reset Circuit)											Initialized. No display appears.
Initialization											Initialized. No display appears.
Display ON/OFF Control											
RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	—	
0	0	0	0	0	0	1	1	1	0		Turn on display and cursor. All display is in space mode because of initialization.
Set DD RAM Address										—	Set RAM address so that the cursor is positioned at the head of 1st line.
0	0	1	0	0	0	0	0	0	0		
Write Data to CG/DD RAM										A _—	Write "A". The DD RAM has already been selected by the initialization performed when the power is turned on. The cursor is incremented by one and shifted to the right.
1	0	0	1	0	0	0	0	0	1		
Write Data to CG/DD RAM										AND	Write "D"
1	0	0	1	0	0	0	1	0	0		
Set DD RAM Address										AND	Set RAM address so that the cursor is positioned at the head of 2nd line.
0	0	1	1	0	0	0	0	0	0	—	
Write Data to CG/DD RAM										AND	Write "A"
1	0	0	1	0	0	0	0	0	1	A _—	
Write Data to CG/DD RAM										AND	Write "2"
1	0	0	0	1	1	0	0	1	0	AND501 20 x 2	
Entry Mode Set										AND	Set mode for display shift at the time of write.
0	0	0	0	0	0	0	1	1	1	AND501 20 x 2	
Return Home										AND	Return both of the display and cursor to the original position (Address 0)
0	0	0	0	0	0	0	0	1	X	AND501 20 x 2	

X = Don't care

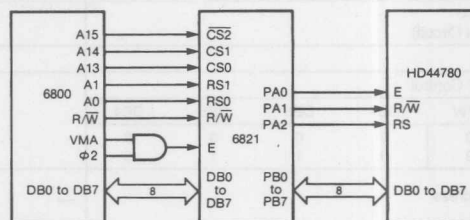


HD44780 Interfaces

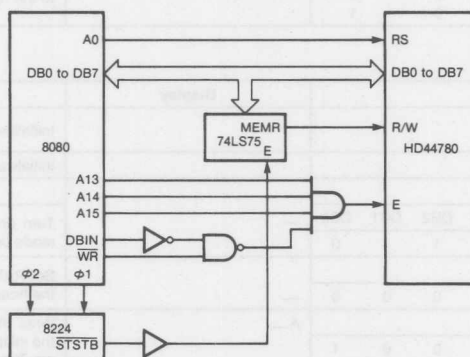
6800



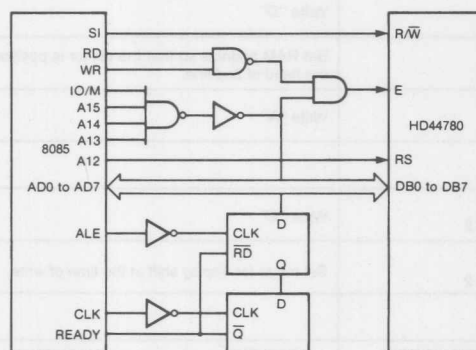
688 with 6821 PIA



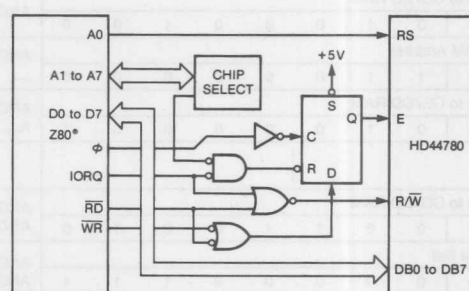
8080



8085



Z80®



Z80 is a registered trademark of Zilog, Inc.

Dot Matrix Connected to a 8085A Based System

The diagram illustrates the hardware configuration for connecting an AND241 dot matrix module to an 8085A microprocessor system. The components and their connections are as follows:

- 8085A Microprocessor:**
 - Power:** V_{ss} and V_{cc} are connected to the top of the chip.
 - Control Signals:** TRAP, RST 7.5, RST 6.5, RST 5.5, INTR, INTA, and ADD/ DATA are on the left. HOLD, HLDA, SOD, SID, S1, S0, and CLK are on the right.
 - Data Bus:** ADD/ DATA, RD, WR, IO/M RST, OUT, RDY, and CLK are connected to the 8156 timer.
 - Other Connections:** X1, X2, and RST IN are at the top. A set of pins at the bottom is labeled "TO OTHER DEVICES".
- 8156 Timer:**
 - Power:** V_{ss} and V_{cc} are connected to the top of the chip.
 - Control Signals:** CE, ALE, RD, WR, IO/M, and RST are connected to the 8085A.
 - Data Bus:** PA7-PA0, ADDR/ TIMER, and PB7-PB0 are connected to the AND241 module.
- AND241 Dot Matrix Module:**
 - Power:** +5V (V_{DD}) and GND are connected to the top and bottom of the module.
 - Control Signals:** E, R/W, and RS are connected to the 8156 timer.
 - Data Bus:** D0 to D7 is connected to the 8156 timer.
 - Internal Structure:** The module contains two 8-bit TRISTATE BUFFERS (labeled X8) and an AND241 dot matrix module.

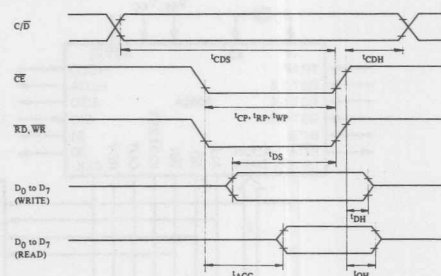


Timing Characteristics

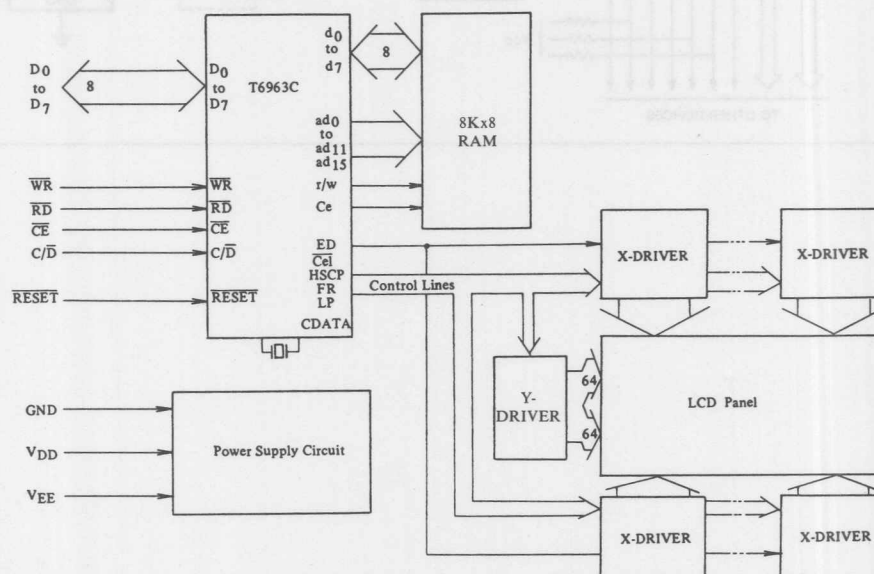
Item	Symbol	Min.	Max.	Unit
C/ \bar{D} Set Up Time	t_{CDS}	100	—	μ s
C/ \bar{D} Hold Time	t_{CDH}	10	—	ns
CE, RD, WR Pulse Width	t_{CP} , t_{RP} t_{WP}	80	—	ns
Data Set Up Time	t_{DS}	80	—	ns
Data Hold Time	t_{DH}	40	—	ns
Access Time	t_{ACC}	—	150	ns
Output Hold Time	t_{OH}	10	50	ns

Conditions: $V_{DD} = 5 \pm 0.25V$, $GND = OV$, $T_a = 25^\circ C$ **Note:** Reset should be actively pulled up.

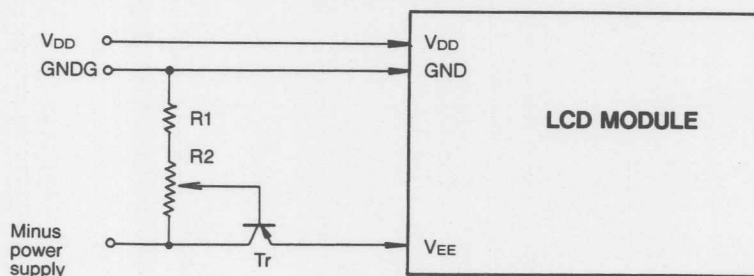
Bus Timing



Block Diagram Example:



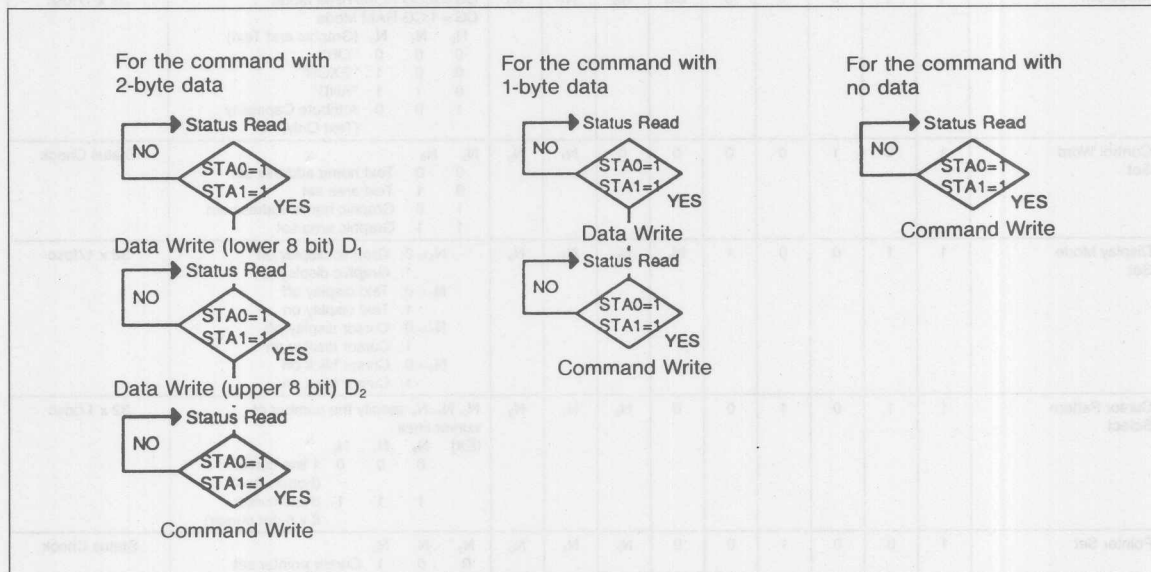
Example of Variable Negative Voltage Supply Circuit



$R_1 = 10k\Omega$ (Example)
 $R_2 = 10k\Omega$ (Example)
(variable resistor)
 $TR: 2SA1162Y$
etc.

Data Transmission Method

The T6963C communicates asynchronously. The following procedure is required for proper operation.



Status Check

Status of controller LSI can be read from 8-bit data lines (D0 to D7) by setting C/D = "H", RD = "L".

Status Register

STA7	STA6	STA5	STA4	STA3	STA2	STA1	STA0
MSB				LSB			

Status should be checked prior to operation, except STA5, which should be checked after the reset command. Following is a table of operations and required status bits:

Operation	Status Bit	Explanation	(Disable-Wait/Enable-Proceed)
Data Read/Write Commands	STA0 (Busy 1)	Check capability of instruction execution	STA0 = 0: Disable = 1: Enable
	STA1 (Busy 2)	Check capability of data read or data write	STA1 = 0: Disable = 1: Enable
Auto read Mode	STA2 (DAV)	Check capability of data read (only effective in auto mode)	STA2 = 0: Disable = 1: Enable
Auto Write Mode	STA3 (RDV)	Check capability of data write (only effective in auto mode)	STA3 = 0: Disable = 1: Enable
Ready	STA4		
	STA5 (CLR)	Check possibility of controller operation	STA5 = 0: Disable = 1: Enable
Screen Peek Screen Copy	STA6 (Error)	Address pointer is out of graphic area on screen peeking and screen copy command	STA6 = 1: Out of Graphic Area
Blink Condition	STA7 (Blink)	Check the condition of blink	STA7 = 0: Display off = 1: Normal Display (on)



Command List

Command	Command Code									Description	Execution Time (MAX)
	C/D	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		
Mode Set	1	1	0	0	0	CG	N ₂	N ₁	N ₀	CG=0:CG ROM/RAM Mode CG=1:CG RAM Mode N ₂ N ₁ N ₀ (Graphic and Text) 0 0 0 "OR" 0 0 1 "EXOR" 0 1 1 "AND" 1 0 0 Attribute Capability (Text Only)	32 x 1/fosc
Control Word Set	1	0	1	0	0	0	0	N ₁	N ₀	N ₁ N ₀ 0 0 Text home address set 0 1 Text area set 1 0 Graphic home address set 1 1 Graphic area set	Status Check
Display Mode Set	1	1	0	0	1	N ₃	N ₂	N ₁	N ₀	N ₃ =0: Graphic display off 1: Graphic display on N ₂ =0: Text display off 1: Text display on N ₁ =0: Cursor display off 1: Cursor display on N ₀ =0: Cursor blink off 1: Cursor blink on	32 x 1/fosc
Cursor Pattern Select	1	1	0	1	0	0	N ₂	N ₁	N ₀	N ₂ , N ₁ , N ₀ specify the number of cursor lines (EX) N ₂ N ₁ N ₀ 0 0 0 1 line cursor (bottom line) 1 1 1 8 line cursor (8 x 8 dot cursor)	32 x 1/fosc
Pointer Set	1	0	0	1	0	0	N ₂	N ₁	N ₀	N ₂ N ₁ N ₀ 0 0 1 Cursor pointer set 0 1 0 Offset resistor set 1 0 0 Address pointer set	Status Check
Data Auto Read/Write	1	1	0	1	1	0	0	N ₁	N ₀	N ₁ N ₀ 0 0 Data auto write set 0 1 Data auto read set 1 * Auto reset After this command, continuous data can be written or read. (address pointer automatically increments)	32 x 1/fosc
Data Read/Write	1	1	1	0	0	0	N ₂	N ₁	N ₀	Data read/write command for 1 byte N ₂ =0: Address pointer up/down 1: Address pointer unchanged N ₁ =0: Address pointer Increment 1 Address pointer Decrement N ₀ =0: Data write 1: Data read	32 x 1/fosc
Screen Peeking	1	1	1	1	0	0	0	0	0	Read displayed data	Status Check
Screen Copy	1	1	1	1	0	1	0	0	0	1 line of display data pointed at by the address pointer is copied into the graphic RAM area.	Status Check
Bit Set/Reset	1	1	1	1	1	N ₃	N ₂	N ₁	N ₀	Set/reset command for a bit in the pointed address by address pointer. N ₃ =0: Bit reset 1: Bit set N ₂ , N ₁ , N ₀ indicates the bit in the pointed address (000 is LSB, and 111 is MSB)	Status Check

Note: 1: "Status check" should be inserted between all command and data information.

2: Written data is displayed on the LCD only after the "Display Mode Set" command has been given.

3: The Display RAM is not automatically cleared upon power up.

4: fosc = 4.6 ± .5 MHz for AND 1013, 1391ST

fosc = 2.3 ± .5 MHz for AND 711, 1021, 682

fosc = 5.75 ± .5 MHz for AND1301VST



Initialization

Command	C/D	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀	Note
Power On	Power On									
Hard Reset (use reset terminal)	RESET = "L" (1msec minimum after VDD ≥ 4.75V)									
Mode Set	1	1	0	0	0	0	0	0	0	
Control Word Set										
Text Home Position Set (text home position 1000H)	0	0	0	0	0	0	0	0	0	Text Home Address Command
	0	0	0	0	1	0	0	0	0	
	1	0	1	0	0	0	0	0	0	
Number of Text Area Set (text 40 characters-0028H)	0	0	0	1	0	1	0	0	0	Number of Area Command
	0	0	0	0	0	0	0	0	0	
	1	0	1	0	0	0	0	0	1	
Graphic Home Position Set (graphic home position 0000H)	0	0	0	0	0	0	0	0	0	Graphic Home Command
	0	0	0	0	0	0	0	0	0	
	1	0	1	0	0	0	0	1	0	
Number of Graphic Area Set (graphic 40 x 6 dots-0028H)	0	0	0	1	0	1	0	0	0	Number of Area Command
	0	0	0	0	0	0	0	0	0	
	1	0	1	0	0	0	0	1	1	
(Initialize End)										

Data Write Examples

	C/D	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀	Note
1) Text Data										
Address Pointer Set (Text Home Address)	0	0	0	0	0	0	0	0	0	Data LSB Data MSB Command
	0	0	0	0	1	0	0	0	0	
	1	0	0	1	0	0	1	0	0	
Data Write "A"	0	0	0	1	0	0	0	0	1	Data Command
	1	1	1	0	0	0	0	0	0	
"N"	0	0	0	1	0	1	1	1	0	Data Command
	1	1	1	0	0	0	0	0	0	
"D"	0	0	0	1	0	0	1	0	0	Data Command
	1	1	1	0	0	0	0	0	0	
Display Mode Set (Text On)	1	1	0	0	1	0	1	0	0	Command
2) Graphic Data										
Address Pointer Set (Graphic Home Address)	0	0	0	0	0	0	0	0	0	Data LSBs Data MSBs Command
	0	0	0	0	0	0	0	0	0	
	1	0	0	1	0	0	1	0	0	
Data Write (Every Other Pixel)	0	0	1	0	1	0	1	0	1	Data Command
	1	1	1	0	0	0	0	0	0	
Data Write (Every Other Pixel)	0	0	1	0	1	0	1	0	1	Data Command
	1	1	1	0	0	0	0	0	0	
Data Write (Every Other Pixel)	0	0	1	0	1	0	1	0	1	Data Command
	1	1	1	0	0	0	0	0	0	
Display Mode Set (Graphics On)	1	1	0	0	1	1	0	0	0	Command
3) Auto Mode Write										
Address Pointer Set (Text Home Address)	0	0	0	0	0	0	0	0	0	Data LSB Data MSB Command
	0	0	0	0	1	0	0	0	0	
	1	0	0	1	0	0	1	0	0	
Enter Auto Mode	1	1	0	1	1	0	0	0	0	Command
"A"	0	0	0	1	0	0	0	0	1	Data Data Data
"N"	0	0	0	1	0	1	1	1	0	
"D"	0	0	0	1	0	0	1	0	0	
Exit Auto Mode	1	1	0	1	1	0	0	1	0	Command
Address Pointer Set (Graphic Home Address)	0	0	0	0	0	0	0	0	0	Data LSB Data MSB Command
	0	0	0	0	0	0	0	0	0	
	1	0	0	1	0	0	1	0	0	
Enter Auto Mode	1	1	0	1	1	0	0	0	0	Command
Graphic Data (Every Other Pixel)	0	0	1	0	1	0	1	0	1	Data Data Data
	0	0	1	0	1	0	1	0	1	
	0	0	1	0	1	0	1	0	1	
Exit Auto Mode	1	1	0	1	1	0	0	1	0	Command
Display Mode Set (Text On - Graphics Off)	1	1	0	0	1	0	1	0	0	Command
Display Mode Set (Graphics On - Text Off)	1	1	0	0	1	1	0	0	0	Command
Display Mode Set (Text On - Graphics On)	1	1	0	0	1	1	1	0	0	Command

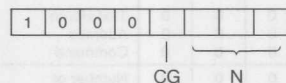
Note: In Auto Write Mode Check status bit 3, for all other operations STA0 and STA1 should be checked.

T6963C Instruction Set

1. Mode Set

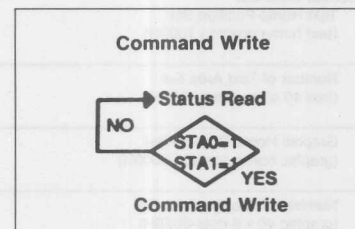
The MODE Set instruction determines how the data in the GRAPHIC and TEXT memories will be displayed. Note that when using the ATTRIBUTE Mode, 84H, the data in the GRAPHIC MEMORY is

interpreted as ATTRIBUTE information and controls the presentation of the TEXT characters (see ATTRIBUTE FUNCTION Page 5-46). For most applications MODE SET = 80H.



Note: Gr = Graphics
TX = Text
CG = Character Generator

N	Mode
000	Gr and TX are logically "ored"
001	Gr and TX are logically "exored"
011	Gr and TX are logically "anded"
100	TX attribute
CG	
0	Internal CG (ROM & RAM)
1	External CG (RAM only)



Modes of Operation

- A) The most common Mode of operation is where the TEXT and GRAPHIC information are logically combined on the screen. In this Mode the ATTRIBUTE FUNCTION is not available. The DISPLAY MODE SET command controls the display of both the TEXT and GRAPHIC memories independently.
- B) A second choice is the ATTRIBUTE FUNCTION Mode. In this Mode the information held in the GRAPHIC MEMORY is interpreted as ATTRIBUTE data and enables the TEXT MEMORY to generate special characters; Inverse, Blinking, etc. To preserve the data in the GRAPHIC MEMORY the user should reassign the GRAPHIC HOME POSITION to the ATTRIBUTE

RAM AREA using the CONTROL WORD SET command, 42H. Note that no Graphic data can be displayed.

- C) The CG BIT controls how the two Character Generators are configured.

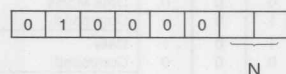
CG BIT = 0

Both Internal and External CG are available with 128 characters each.

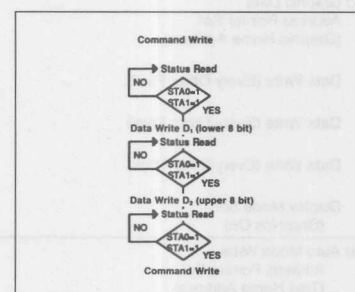
CG BIT = 1,

The Internal CG is not available. The External CG can hold up to 256 characters.

2. Control Word Set



	N	Mode	D ₁	D ₂
A	00	Text Home Address	A low	A high
B	01	Text Area Set	column	00H
C	10	Graph. Home Address	A low	A high
D	11	Graphic Area Set	column	00H



This set of instructions initializes the TEXT and GRAPHIC MEMORY locations.

- A) TEXT HOME ADDRESS: 40H – This command sets the address in RAM of the first character in the TEXT MEMORY.
- B) TEXT AREA SET: 41H – The TEXT AREA command defines the number of characters in one row of the TEXT display.
- C) GRAPHIC HOME ADDRESS: 42H – This command sets the Home or First address in the GRAPHIC MEMORY. When using the attribute function, the GRAPHIC HOME ADDRESS must be reassigned to the starting address of the ATTRIBUTE RAM AREA.

- D) GRAPHIC AREA SET: The GRAPHIC AREA SET command defines the number of GRAPHIC Words in one GRAPHIC Row. The GRAPHIC AREA is equal to the TEXT AREA.
- TH = TEXT HOME
TA = TEXT AREA
CH = DISPLAY CHARACTER COLUMNS (Hardware Set)
GH = GRAPHIC HOME
GA = GRAPHIC AREA

**1. TEXT Display**

TH		TH + CH
TH + TA		TH + TA + CH
(TH + TA) + TA		TH + 2TA + CH
(TH + 2TA) + TA		TH + 3TA + CH
TH + (n-1)TA		TH + (n-1)TA + CH
TH + nTA		TH + nTA + CH

EXAMPLE:

AND1021 120 x 64 Pixels

8 x 8 Character Font

15 Characters x 8 Lines

TEXT HOME = TH = 1000H

TEXT AREA = TA = 15 Characters
000FH

See Page 5-47 for Suggested Module Memory Mapping

2. GRAPHIC Display

GH		GH + CH
GH + GA		GH + GA + CH
(GH + GA) + GA		GH + 2GA + CH
(GH + 2GA) + GA		GH + 3GA + CH
GH + (n-1)GA		GH + (n-1)GA + CH
GH + nGA		GH + nGA + CH

EXAMPLE:

AND1021 120 x 64 Pixels

8 x 8 Character Font

15 Characters x 8 Lines

GRAPHIC HOME = GH = 0000H

GRAPHIC AREA = GA = 000FH

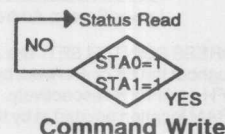
3. Display Mode Set

This command controls the display of the TEXT and GRAPHIC Displays as well as the CURSOR.

To turn both the TEXT and Graphic Displays ON, bit A and B would be HIGH. For a TEXT Display, only bit B would be HIGH.

1	0	0	1	A	B	C	D
---	---	---	---	---	---	---	---

A	1/0	Graphic ON/OFF
B	1/0	Text ON/OFF
C	1/0	Cursor ON/OFF
D	1/0	Cursor Blink ON/OFF

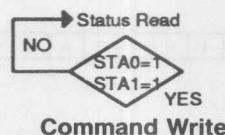
Command Write**4. Cursor Pattern Select**

A standard 1 line Cursor is generated with the command of A0H while A7H generates an 8 line, or Character Block, CURSOR.

1	0	1	0	0			
---	---	---	---	---	--	--	--

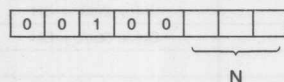
N

N	Display Pattern
111	8 line cursor
110	7 line cursor
101	6 line cursor
100	5 line cursor
011	4 line cursor
010	3 line cursor
001	2 line cursor
000	1 line cursor

Command Write



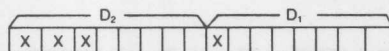
5. Pointer Set



POINTER SET

The POINTER SET command controls the CURSOR POINTER, ADDRESS POINTER and the EXTERNAL CHARACTER GENERATOR OFFSET REGISTER.

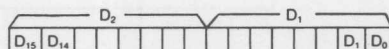
- A) CURSOR POINTER SET: The CURSOR is displayed at the position specified by the CURSOR POINTER.
 D₁ HORIZONTAL POINT IN CHARACTERS (MSB DONT CARE)
 D₂ VERTICAL POINT IN CHARACTERS (3 MSB DONT CARE)



NOTE: For the AND1091/1013 the LOWER SCREEN CURSOR can be addressed by adding 1000H to the CURSOR ADDRESS, D2-D1.

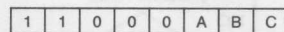
EXAMPLE: Upper Screen Address 1000H For AND1091
 Add Off Set 1000H and 1013 Only
 Lower Screen Address 2000H

- B) ADDRESS POINTER SET: The ADDRESS POINTER may move throughout the 8K or 4K RAM, beginning at 0000H and ending at 1FFFH or 0FFFH respectively. All data transfer takes place at the RAM location pointed at by the ADDRESS POINTER or ADP.



6. Data Read/Write

Data transfer occurs at the address pointed at by the ADDRESS POINTER.



This instruction is a 1 byte data Read/Write command.

A	B	C	MODE
0	0	0	Data Write ADP increment
0	0	1	Data Read ADP increment
0	1	0	Data Write address pointer decrement
0	1	1	Data Read address pointer decrement
1	*	0	Data Write ADP nonvariable
1	*	1	Data read ADP nonvariable

* don't care

	N		D ₁	D ₂
A	001	Cursor Pointer Set	Ax (7 bit)	Ay (5 bit)
B	100	Address Pointer Set	A low	A high
C	010	Offset Register Set	DATA (5 bit)	00H

- C) OFFSET REGISTER SET: THE OFFSET REGISTER SET command specifies the area in RAM which is used for the EXTERNAL Character generator.

The MSB is 00H and the LSB is the Upper 5 bits of the External CG RAM location.

See: EXTERNAL CHARACTER GENERATOR Page 5-42.

EXAMPLE: Set OFFSET REGISTER with the External CG Home Position equal to 1C00H.

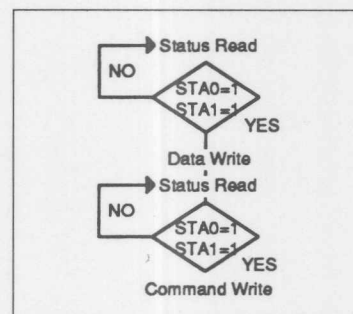
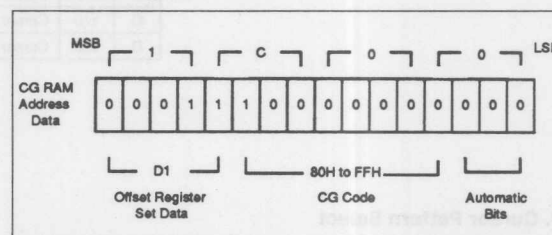
LSB DATA = 03H

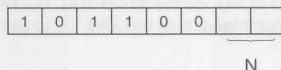
MSB DATA = 00H

OFFSET REGISTER

SET COMMAND = 22H

External CG Register:

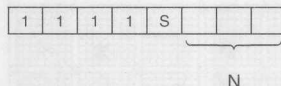


**7. Auto Mode**

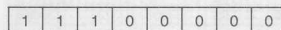
This instruction is continuous data to Read (or Write) command. Auto Mode operations should be performed after checking status -STA2 or STA3.

8. Bit Set/Reset

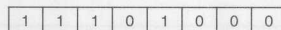
This instruction manipulates individual pixels. The bit is SET/RESET by this command. The ADP points to the byte in GRAPHIC RAM where the bit is to be changed.



S
1: Set
0: Reset

9. Screen Peeking

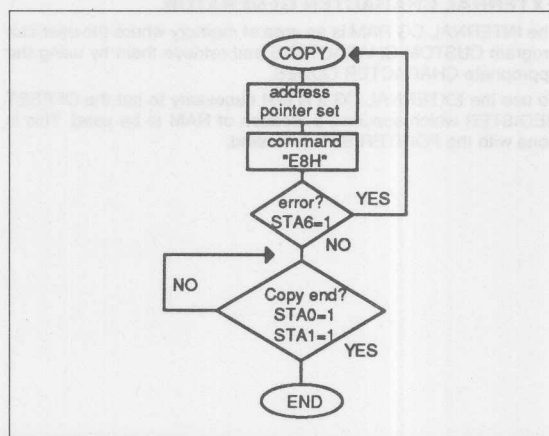
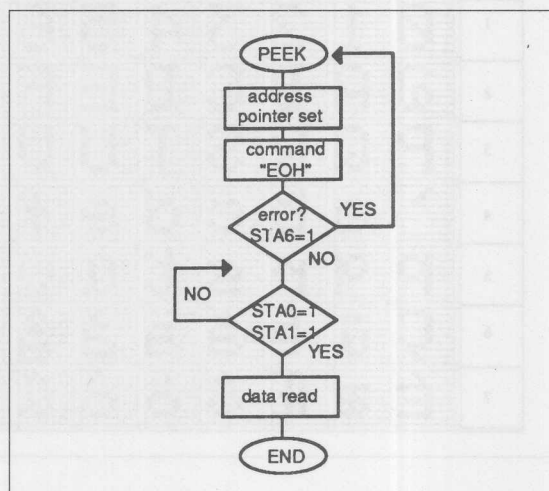
This instruction puts 1 byte of displayed data on the 8 bit bus for a Read Operation. It is possible to read logical combination data. If the address pointer is not set to the Graphic RAM area, this instruction is ignored and status bit 6 is set.

10. Screen Copy

This command copies 1 line of Text or logical Graphics-Text data from the display to the Graphic RAM. If the address pointer is not set to the Graphic RAM area, this instruction is ignored and status bit 6 is set.

N	Mode
00	Data Auto Write Set
01	Data Auto Read Set
10	Auto Reset (Exit Auto Mode)

N	Mode
000	bit 0 (LSB)
001	1
010	2
011	3
100	4
101	5
110	6
111	7 (MSB)





Character Generator

The user has a choice of using both the INTERNAL and EXTERNAL Character Generators, with 128 characters each, or using the EXTERNAL CG with 256 characters. The CG bit in the MODE SET command controls this designation.

MODE	SET	CG	BIT	CHARACTERS	
				ROM	RAM
		0		128	128
		1		0	256

INTERNAL CHARACTER GENERATOR

The following chart illustrates the relationship between CHARACTER CODE and CHARACTER FONT for the INTERNAL CG ROM. The CG bit of the MODE SET command must be LOW, '0', to use the INTERNAL CG.

LSB MSB	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0		!	"	#	\$	%	&	'	()	*	+	,	-	.	/
1	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
2	a	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
3	P	Q	R	S	T	U	V	W	X	Y	Z	[\]	^	_
4	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
5	p	q	r	s	t	u	v	w	x	y	z	{		}	~	
6	ÿ	ü	é	à	á	â	ã	ä	å	æ	ç	è	é	ê	ë	
7	É	è	Ê	á	â	ã	ä	å	æ	ç	ø	ö	ó	ô	õ	

EXTERNAL CHARACTER GENERATOR

The INTERNAL CG RAM is an area of memory where the user can program CUSTOM CHARACTERS and retrieve them by using the appropriate CHARACTER CODES.

To use the EXTERNAL CG it is first necessary to set the OFFSET REGISTER which specifies a location of RAM to be used. This is done with the POINTER SET command.

The EXTERNAL CG can then be programmed with custom characters.

Once programmed, the EXTERNAL CG can then be used in place of, or in conjunction with, the INTERNAL CG.

Mode set command and CG accessibility:

Mode Set	CG Bit	CG ROM	CG RAM
Internal CG Bit = 0	0	128	128
External CG Bit = 1	1	0	256

**EXTERNAL CHARACTER GENERATOR (cont'd)**

The CG bit of the MODE SET command controls the configuration of the INTERNAL, ROM, and EXTERNAL, RAM, character generators.

- 1) THE CG BIT IN THE MODE SET COMMAND IS HIGH, '1'. BOTH THE ROM, INTERNAL, AND RAM, EXTERNAL, CHARACTER GENERATORS ARE AVAILABLE. THERE ARE 128 CHARACTERS AVAILABLE IN EACH CG WITH ROM CHARACTER CODES FROM 00H TO 7FH AND RAM CODES FROM 80H TO FFH.

There are 8 bytes of data for each character in the EXTERNAL CG resulting in a memory requirement of 0400H.

Because the address of the EXTERNAL CG contains the CHARACTER CODE information, as shown below, the available CG RAM addresses are the following.

0400H	0C00H	1400H	1C00H
to	to	to	to
07FFH	0FFFH	17FFH	1FFFH

The RECOMMENDED AREA is 1C00H to 1FFFH.

This results in the LSB OFFSET REGISTER data of 03H.

MSB = 00H LSB = 03H

- 2) The CG bit of the MODE SET command is LOW, '0'. The ROM is not available and the RAM, or EXTERNAL CG, can accommodate 256 characters. Eight bytes per character results in a memory requirement of 0800H.

The possible RAM addresses are the following.

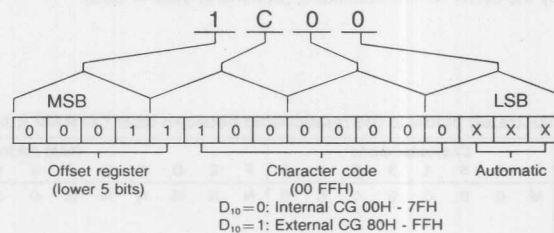
0000H	0800H	1800H
TO	TO	TO
07FFH	0FFFH	1FFFH

The recommended EXTERNAL CG RAM area is 1800H to 1FFFH.

This results in the LSB OFFSET REGISTER data of 03H.

MSB = 00H LSB = 03H

EXAMPLE: Address of external character generator.

**DISPLAYING USER CHARACTER GENERATOR RAM**

Character patterns can be displayed by sending the CG code with the "Data Write" command. "Display Mode Set" for TEXT display should be selected before using the CG.

WRITING TO THE EXTERNAL CHARACTER GENERATOR RAM

User defined characters can be written into the EXTERNAL CG RAM and retrieved with the appropriate character codes.

Each custom character requires 8 bytes of data sent to consecutive addresses. The information for the top row of pixels in the first custom character will be stored at the EXTERNAL CG HOME address specified by the OFFSET REGISTER SET command.

EXAMPLE:

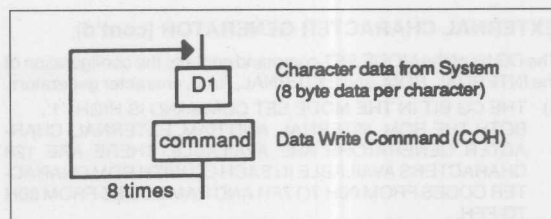
Example: CG RAM start address is 1 C00H, "Address Pointer Set" (command data = 24H) requires 2 byte address data. D₁ and D₂. The procedure of data transfer is as follows.

D₁ Address data—lower 8-bit (00H)

D₂ Address data—upper 8-bit (1CH)

Command	Address Pointer Set command (24H)
---------	-----------------------------------

The system character data, (Character Data = D₁), is downloaded by the DATA WRITE command, (Command Data = C0H).



CG RAM address	CG RAM Data (80H)							
	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀
1C00H	+	+	*	*	*	*	*	*
1C01H	+	+	*	*	*	*	*	*
1C02H	+	+	*	*	*	*	*	*
1C03H	+	+	*	*	*	*	*	*
1C04H	+	+	*	*	*	*	*	*
1C05H	+	+	*	*	*	*	*	*
1C06H	+	+	*	*	*	*	*	*
1C07H	+	+	*	*	*	*	*	*

This operation should be repeated for each character.

Illustrated below is the relationship between User CG RAM Address and CG Code and Character Pattern

Character Code								RAM Address for User CG														Character Pattern																														
7	6	5	4	3	2	1	0	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0																					
M	0	0	0	0	0	0	0	N	N	N	N	N	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																					
																								0	0	0	0	0	0	0	0																					
																								0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
																								0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
																								0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	0	0
																								1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
																								1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																							
1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																						
1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																					
1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																					
1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																					
1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																					

NOTE: 1: The character code in User RAM is located from 80H to FFH for MODE SET command - CG Bit = 0, and from 00H to FFH for MODE SET command - CG Bit = 1.

BIT M=1; CG BIT = 0 for the MODE SET command
(Internal CG ROM and External CG RAM)

BIT M=0; CG BIT = 1 for the MODE SET command
(External CG RAM only)

2: 'NNNNN' is the upper 5 Bits in the start address of the User CG RAM area as defined by the POINTER SET command - OFFSET REGISTER SET option.

3: Care should be taken as to not over write the CG RAM area with display data.



External Character Generator Write Example

	C/D	D7	D6	D5	D4	D3	D2	D1	D0	Status Check	Comments
Address Pointer Set Data (LSB)	0	0	0	0	0	0	0	0	0	Bit 0, 1	Set ADP to 1C00H Start of external CG RAM Status check before operation
Address Pointer Set Data (MSB)	0	0	0	0	1	1	1	0	0	Bit 0, 1	
Address Pointer Set Command	1	0	0	1	0	0	1	0	0	Bit 0, 1	
Auto Mode	1	1	0	1	1	0	0	0	0	Bit 0, 1	Enter auto write mode
Character Data	0	0	0	0	0	0	0	0	0	Bit 3	First byte of Data for a user defined character This example is an upside down letter "A"
"	0	0	0	0	1	0	0	0	1	Bit 3	
"	0	0	0	0	1	0	0	0	1	Bit 3	
"	0	0	0	0	1	1	1	1	1	Bit 3	
"	0	0	0	0	1	0	0	0	1	Bit 3	Note that status bit 3 is checked while in auto write mode
"	0	0	0	0	1	0	0	0	1	Bit 3	
"	0	0	0	0	1	0	0	0	1	Bit 3	
Character Data	0	0	0	0	0	1	1	1	0	Bit 3	Eighth byte of data
Auto Set	1	1	0	1	1	0	0	1	X	Bit 3	Exit auto mode

External Character Generator Read Example (After Initialization)

	C/D	D7	D6	D5	D4	D3	D2	D1	D0	Status Check	Comments
Offset Register Data (LSB)	0	0	0	0	0	0	0	1	1	Bit 0, 1	The offset register, (0003H), is equal to the first five bits of the external CG home address (1C00H)
Offset Register Data (MSB)	0	0	0	0	0	0	0	0	0	Bit 0, 1	
Offset Register Set Command	1	0	0	1	0	0	0	1	0	Bit 0, 1	
Data Write Character Code	0	1	0	0	0	0	0	0	0	Bit 0, 1	First character in external CG
Data Write Command	1	1	1	0	0	0	0	0	0	Bit 0, 1	Note: When the CG Bit of the mode set command is "0", the address of the first character in the external CG RAM is 80H. When the CG bit is "1", the address of the first character is 00H.
Data Write Character Code	0	1	0	0	0	0	0	0	1	Bit 0, 1	
Data Write Command	1	1	1	0	0	0	0	0	0	Bit 0, 1	
Data Write Character Code	0	1	0	0	0	0	0	1	0	Bit 0, 1	
Data Write Command	1	1	1	0	0	0	0	0	0	Bit 0, 1	Fourth character in external CG
Data Write Character Code	0	1	0	0	0	0	0	1	1	Bit 0, 1	Data write command, ADP increment
Data Write Command	1	1	1	0	0	0	0	0	0	Bit 0, 1	
Display Mode Set	1	1	0	0	1	0	1	0	0	Bit 0, 1	Turn text display on



Attribute Functions

The attribute function is used for a "reverse" and/or "blinking" display.

To use the attribute function, it is first necessary to reassign the graphic home address to the first address of the attribute RAM area by using the internal RAM write command. Please note that graphic data cannot be displayed. Second, it is necessary to enter the desired attribute data (see the following table) using the "Data Write" command.

Attribute RAM-1 byte

*	*	*	*	N ₃	N ₂	N ₁	N ₀
---	---	---	---	----------------	----------------	----------------	----------------

* don't care

N ₃	N ₂	N ₁	N ₀	Function
0	0	0	0	Normal display (text only)
0	1	0	1	Reverse display (text only)
0	0	1	1	Inhibit display
1	0	0	0	Blink of normal display
1	1	0	1	Blink of reverse display
1	0	1	1	Inhibit display

The attribute data of the first character in "text area" is written into the first 1 byte in "attribute RAM area", and the attribute data of nth character is written at the nth byte in "attribute RAM area".

Example:

Command	C/D	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀	Note
Graphic display off	1	1	0	0	1	0	*	*	*	
Graphic home address set to attribute home address	0	0	0	0	0	0	0	0	0	home address command
	0	0	0	0	1	1	1	1	0	
	1	0	1	0	0	0	1	0	0	
Attribute data write	0	0	0	0	0	0	0	0	0	address D ₁ , D ₂
	0	0	0	0	1	1	1	1	0	
	1	0	0	1	0	0	1	0	0	address pointer set
	0	0	0	0	0	0	0	0	0	attribute data write command
	1	1	1	0	0	0	0	0	0	
	0	0	0	0	0	1	1	0	1	attribute data write command
	1	1	1	0	0	0	0	0	0	
	*	*	*	*	*	*	*	*	*	
	*	*	*	*	*	*	*	*	*	
	*	*	*	*	*	*	*	*	*	
Mode Set	1	1	0	0	0	0	1	0	0	
Graphic Display On	1	1	0	0	1	1	*	*	*	



Suggested Module Memory Mapping

AND	711A, 1301, 1391 6 x 8	711A, 1301, 1391 8 x 8	1021	682	1101	1013	1091
Text Home	1000H	1000H	1000H	0A00H	1000H	0A00H	0A00H
Text Area	0028H	001EH	000FH	0014H	0014H	0014H	001EH
Graphic Home	0000H	0000H	0000H	0000H	0000H	0000H	0000H
Graphic Area	0028H	001EH	000FH	0014H	0014H	0014H	001EH
Ext. CG Home	1C00H	1C00H	1C00H	0C00H	1C00H	0C00H	0C00H
Attribute Home	0D00H	0D00H	0D00H	0800H	0D00H	0800H	0800H
Valid Address (note)	0000H to 1FFFFH	0000H to 1FFFFH	0000H to 1FFFFH	0000H to 0FFFFH	0000H to 1FFFFH	0000H to 0FFFFH and 8000H to 8FFFFH	0000H to 0FFFFH and 8000H to 8FFFFH

RAM Map

Display RAM is built-in the module, and display data is written to this display RAM. Built-in controller LSI T6963C is automatically read from display RAM, and sends data to LCD drivers. "Control word set" command (text home set, text area set, etc.) defines the RAM area which is read by controller LSI, so RAM map can be changed by user's preference.

If more than 1 screen is stored in the RAM, vertical scrolling and paging is easily performed by resetting text home and/or graphic home address.

These modules have 8k byte built-in RAM, and the following is an example of RAM mapping.

RAM MAP For AND
711A/1021/1101/1301/1391

0000H	Graphic RAM Area
0D00H	
	Attribute RAM Area
1000H	
	Text RAM Area
1C00H	
	CG RAM Area

RAM MAP For AND 1013/1091
(upper half screen)

0000H	Graphic RAM Area
0800H	
	Attribute RAM Area
0A00H	
	Text RAM Area
0C00H	
	CG RAM Area
0FFFFH	

RAM MAP For AND 1013/1091
(lower half screen)

8000H	Graphic RAM Area
8800H	
	Attribute RAM Area
8A00H	
	Text RAM Area
8C00H	
	Not used
8FFFFH	

RAM MAP For AND 682A

0000H	Graphic RAM Area
0800H	
	Attribute RAM Area
0A00H	
	Text RAM Area
0C00H	
	CG RAM Area

Note 1: If graphic/text home address is specified only for upper half screen, RAM map of lower half is automatically fixed.

Note 2: Above example of RAM map is for "CG ROM Mode", in case of "CG RAM Mode" is selected, 2048 byte CG RAM area is necessary. So above RAM map should be relocated.

For installation of the LCD module, please use four mounting holes located at the corners of PCB.

The bezel is not intended to be used as a cosmetic purpose. The proper protective cover (lens) over the LCD surface and the proper enclosure are recommended to be attached in order to prevent polarizer surface from scratching or staining. The transparent opening dimensions of protective cover are recommended to be smaller than the viewing area.

Handling

- Refrain from strong mechanical shock and applying any force to the display plane. Otherwise, it may cause malfunction or damage to LCD.
- In case of leakage of liquid crystal material, avoid ingestion, inhalation or contact with skin. If liquid crystal material sticks to skin, wash immediately with alcohol and rinse thoroughly with water.
- Note that polarizers are so soft as to be easily damaged. Do not press polarizer surface with any hard object.
- The polarizer laminated to the LCD and adhesives used to adhere them may be attacked by organic solvent. When LCD surface becomes dirty, wipe softly with absorbent cotton soaked in benzene.
- Refrain from the discharge of high electro-static voltage. It will damage CMOS LSI in the module.

- Do not leave the module in high temperature, especially in high humidity for a long time. It is recommended to store the module on the place where the temperature range is 0°C to +35°C, and the humidity is lower than 70%.

- Store the module without exposure to the direct sunlight.

Operation

- Do not insert or remove LCD module from main system with power applied.
- Power supplies should always be turned on before the independent input signal sources turned on, and input signals should be turned off before power supplies are turned off.

Others

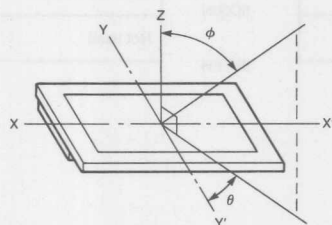
- Ultraviolet ray cut filter is necessary for outdoor operation.
- Avoid condensation of water, it may cause misoperation or disconnection of electrode.
- Do not exceed maximum ratings value under the worst probable conditions with respect to supply voltage variation, input voltage variation, environmental temperature, etc.



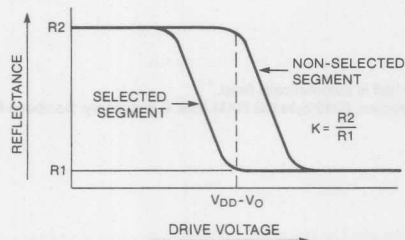
LCD Dot Matrix Modules

OPTICAL DEFINITIONS

Note 1 Definition of ϕ and θ



Note 3 Definition of Contrast



R1 = Reflectance of selected segment
R2 = Reflectance of non-selected segment (Group dots measurement)

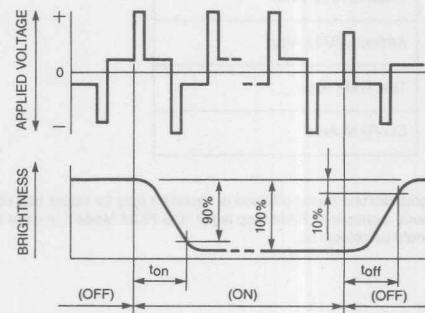
Note 2

Definition of Viewing Angle

The range of viewing angles, adjusted by varying the V_{EE} value, which produce a higher than specified contrast ratio.

Note 4

Definition of Rise and Decay Time



LCD DRIVERS

Intersil
10710 N. Tantau Ave.
Cupertino, CA 95014
Tel: 408-996-5000

ELECTROLUMINESCENT INVERTERS

Endicott Research Group, Inc.
2601 Wayne Street
P.O. Box 269
Endicott, New York 13760
Tel: 607-754-9187

LCD CONTROLLERS

Yamaha
981 Ridder Park Dr.
San Jose, CA 95131
Tel: 408-437-3133

Vadem
1885 Lundy Ave. #201
San Jose, CA 95131
Tel: 408-943-9301

TOUCH PANELS/SCREENS

C.A.M. Graphics Co., Inc.
15 Ranick Drive West
Amityville, N.Y. 11701
Tel: 516-842-3400
FAX: 516-842-1005

MicroTouch Systems, Inc.
Ten State Street
Woburn, MA 01801
Tel: 617-935-80

Sierracin Transflex
5600 Bandini Blvd.
Bell, CA 90201-6407
Tel: 213-269-9100
FAX: 213-264-8336

Transparent Devices, Inc.
756 Lakefield Road, Suite H
Westlake Village, CA 91361
Tel: 805-497-8500

DISPLAY HEATERS

Midwest Components
P.O. Box 787
1981 Port City Blvd.
Muskogee, MI 49443
Tel: 616-777-2602

Minco Products, Inc.
7300 Commerce Lane
Minneapolis, MN 55432
Tel: 612-571-3121
FAX: 612-571-0927

Photofabrication Technology, Inc.
Century Building
Derry, N.H. 03038
Tel: 603-434-4113

Sierracin Transflex
5600 Bandini Blvd.
Bell, CA 90201-6407
Tel: 213-269-9100
FAX: 213-264-8336

Springfield Wire
243 Cottage Street
Springfield, MA 01101
Tel: 413-781-6950

FILTER MATERIALS

Caloric Color Co.
176 Saddle River Ave.
Garfield, N.J. 07026
Tel: 201-471-4748

Homalite
11 Brookside Drive
Wilmington, DE 19804
Tel: 302-652-3686

JMJ Technical Products
50 Wheeler Point Road
Newark, N.J. 07105
Tel: 201-589-4257

Panelgraphic Corp.
10 Henderson Dr.
W. Caldwell, N.J. 07006
Tel: 201-227-1500

CUSTOM BEZELS For Pinless Displays

Conductive Rubber Technology
201 N. Salsipuedes #100
Santa Barbara, CA 93103
Tel: 805-965-6511

Technit Interconnection Products
135 Bryant Ave.
Cranford, N.J. 07016
Tel: 201-272-5500

CUSTOM BEZELS For Pinned Displays

JMJ Technical Products
50 Wheeler Point Road
Newark, N.J. 07105
Tel: 201-589-4257

RMF Products
P.O. Box 520
Batavia, IL 60510
Tel: 312-879-0020

ELASTOMERIC CONNECTORS

Conductive Rubber Technology
201 N. Salsipuedes
Suite #100
Santa Barbara, CA 93103
Tel: 805-965-6511

PCK Elastomerics, Inc.
2940 Turnpike Dr.
Suite 17
Hatboro, PA 19040
Tel: 215-672-0787

Shin-Etsu Polymer America
34135 7th Street
Union City, CA 94587
Tel: 415-475-9000

Technit Interconnection Products
135 Bryant Ave.
Cranford, N.J. 07016
Tel: 201-272-5500

CLIP ON PIN CONNECTORS For Pinless LCDs

Power Dynamics, Inc.
P.O. Box 539
59 Lakeside Avenue
West Orange, N.J. 07052
Tel: 201-736-5722
FAX: 201-736-8930

Teledyne Kinetics
410 S. Cedros Ave.
Solana Beach, CA 92075
Tel: 619-755-1181

HEAT SEAL CONNECTORS For Pinless LCDs

Elform
P.O. Box 7362
Reno, NV 89510
Tel: 702-356-1734

SOCKETS/CONNECTORS

Aris Electronics, Inc.
P.O. Box 130
62 A Trenton Ave.
Frenchtown, N.J. 08825
Tel: 201-996-6841

Augat
33 Perry Ave.
Attleboro, MA 02703
Tel: 617-222-2202

Robinson Nuggent, Inc.
800 East Eighth St.
New Albany, IN 47150
Tel: 812-945-0211

